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PUBLIC DOCUMENT . . . . . . . . No. 4.

# FORTY-FIRST

# ANNUAL REPORT OF THE SECRETARY

OF THE

# MASSACHUSETTS

# STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

# ELEVENTH ANNUAL REPORT OF THE STATE AGRICULTURAL EXPERIMENT STATION.

1893.

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# STATE BOARD OF AGRICULTURE, 1894.

## Members ex Officio.

His Excellency FREDERIC T. GREENHALGE.
His Honor ROGER WOLCOTT.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
Hon. WM. R. SESSIONS, *Secretary of the Board.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*

## Members appointed by the Governor and Council.

| | Term Expires. |
|---|---|
| D. A. HORTON of Northampton, | 1895 |
| JAMES S. GRINNELL of Greenfield, | 1896 |
| SPRAGUE S. STETSON of Lakeville, | 1897 |

## Members chosen by the Incorporated Societies.

| | | |
|---|---|---|
| *Amesbury and Salisbury (Agr'l and Hort'l),* | F. W. SARGENT of Amesbury, | 1897 |
| *Attleborough (Agr'l Assoc'n),* | ISAAC ALGER of Attleborough, | 1897 |
| *Barnstable County,* | JOHN BURSLEY of West Barnstable, | 1895 |
| *Berkshire,* | SAMUEL M. RAYMOND of Hinsdale, | 1897 |
| *Blackstone Valley,* | HENRY A. COOK of Northbridge (P. O. Whitinsville), | 1897 |
| *Bristol County,* | N. W. SHAW of North Raynham, | 1896 |
| *Deerfield Valley,* | CHAS. E. WARD of Buckland, | 1896 |
| *Eastern Hampden,* | W. M. TUCKER of Monson, | 1897 |
| *Essex,* | F. H. APPLETON of Peabody (P.O Lynnfield), | 1896 |
| *Franklin County,* | J. C. NEWHALL of Conway, | 1895 |
| *Hampden,* | F. E. CLARK of Wilbraham, | 1897 |
| *Hampshire,* | L. W. WEST of Hadley, | 1895 |
| *Hampshire, Franklin and Hampden,* | C. B. LYMAN of Southampton, | 1897 |
| *Highland,* | H. A. BARTON, Jr., of Dalton, | 1896 |
| *Hillside,* | WM. BANCROFT of Chesterfield, | 1896 |
| *Hingham (Agr'l and Hort'l),* | EDMUND HERSEY of Hingham, | 1897 |
| *Hoosac Valley,* | WM. H. GOVE of North Adams (P. O. Blackinton), | 1897 |
| *Housatonic,* | F. A. PALMER of Stockbridge, | 1897 |
| *Marshfield (Agr'l and Hort'l),* | JOHN H. BOURNE of Marshfield, | 1897 |
| *Martha's Vineyard,* | H. G. NORTON of West Tisbury, | 1895 |
| *Massachusetts Horticultural,* | E. W. WOOD of West Newton, | 1897 |
| *Middlesex North,* | A. C. VARNUM of Lowell, | 1895 |
| *Middlesex South,* | ISAAC DAMON of Wayland (P.O. Cochituate), | 1896 |
| *Nantucket,* | J. S. APPLETON, Jr., of Nantucket, | 1897 |
| *Oxford,* | JOHN E. KIMBALL of Oxford, | 1895 |
| *Plymouth County,* | AUGUSTUS PRATT of North Middleborough, | 1896 |
| *Spencer (Far's and Mech's Assoc'n),* | EDWARD WARREN of Leicester (P. O. Spencer), | 1895 |
| *Union (Agr'l and Hort'l),* | G. C. ROWLEY of Blandford, | 1895 |
| *Weymouth (Agr'l and Ind'l),* | QUINCY L. REED of South Weymouth, | 1897 |
| *Worcester,* | C. L. HARTSHORN of Worcester, | 1896 |
| *Worcester East,* | W. A. KILBOURN of South Lancaster, | 1897 |
| *Worcester North,* | GEORGE CRUICKSHANKS of Fitchburg, | 1896 |
| *Worcester North-west (Agr'l and Mech'l),* | WM. H. BOWKER of Boston, | 1895 |
| *Worcester South,* | G. L. CLEMENCE of Southbridge (P. O. Globe Village), | 1895 |
| *Worcester County West,* | E. A. HARWOOD of North Brookfield, | 1896 |

# THE FORTY-FIRST ANNUAL REPORT

OF THE

# SECRETARY

OF THE

# BOARD OF AGRICULTURE.

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*To the Senate and House of Representatives of the Commonwealth of Massachusetts.*

The year 1893, judging by the returns of crop correspondents made to this office November 1, was hardly an average one for profit to our farmers. The majority of correspondents reported the season to have been either a poor season or one not up to the average. Very few referred to it as more than average. Much of this was due to the drought of the early season, which cut many crops short, and much to the slow sale of agricultural products.

## Massachusetts Weather.

January, 1893, was a remarkably cold month, the average deficiency in temperature being 6°. The highest temperature was 60°, at Fall River, on the 29th, and the lowest —23°, at Middleborough, on the 17th. The only colder months during the past twenty years have been January, 1875, January, 1881, February, 1885, and January, 1888. The precipitation was about one inch below the normal. The prevailing wind direction was northwest, and the greatest velocity, 88 miles an hour from the southeast, was at Blue Hill, on the 2d.

February was below the normal in temperature, the average deficiency being slightly more than a degree. The highest temperature was 57°, at Lake Cochituate, on the 15th; the lowest — 11°, at Ludlow, on the 21st. Precipitation was heavy and much above normal. The snowfall was remarkably heavy, being 6 feet 6 inches at Monroe. The prevailing winds were from the northwest, the highest velocity being 72 miles per hour.

The temperature departure for March was — 1.5°. The highest temperature was 64°, at Plymouth, on the 24th, and the lowest — 6°, at Lake Cochituate, on the 3d, and at Monroe on the 9th. Precipitation and snowfall were both below normal. Prevailing winds were from the northwest, and the greatest velocity was 61 miles per hour from the northwest, at Blue Hill, on the 16th.

In April the average departure was — 1.5°. At Blue Hill it was the coldest April since 1888. The precipitation averaged about normal, but was unevenly distributed, — the departure at Amherst being +1.32 inches, and at Cambridge — 0.93 inches. Snow fell on the 7th and 8th to an average depth of 6 inches, but remained on the ground scarcely twenty-four hours. Twenty-one inches was reported at Monroe. The prevailing winds were from the northwest, and the maximum velocity was 61 miles per hour from the west, at Blue Hill, on the 5th.

The temperature for the month of May averaged very nearly normal in eastern Massachusetts, and slightly below in western sections. Light frosts were reported on the 7th, 8th and 9th, but no damage was done. The precipitation was above normal and heavy in most sections, the average departure being +1.31 inches. At most stations more than half the rain of the month fell in the first six days. Considerable damage was done by the rain of the 3d and 4th. No severe thunderstorms occurred. Prevailing wind direction, southwest and west.

The mean temperature for June was slightly below the normal, and the precipitation, except on Cape Cod, was also deficient. The latter part of the month was unusually cool, owing to easterly winds. The rainfall averaged 3.20

inches, or about an inch below the normal. Several light thunderstorms occurred. No high gales were noted, although the wind movement was greater than usual. The percentage of relative humidity was considerably above the average for June.

In July the temperature varied but slightly from the normal, but the precipitation was decidedly deficient. Showers were frequent, but little damage was done, and the rainfall was light and unevenly distributed. On the 25th the minimum temperature ranged from 40° to 54°, and a light frost occurred at Taunton. Sunshine was considerably more than average, only five cloudy days being recorded at Boston. No violent windstorms were reported, although some damage was done in various parts of the State during several thunderstorms. The prevailing wind direction was west. Hail occurred at Worcester on the 5th.

August will long be remembered as a month of numerous storms of unusual severity. Thunderstorms were severe, but not frequent. The storm of the 6th was almost a tornado at Taunton, accompanied by severe hail, and at Lynn the damage by lightning and flood was estimated at $75,000. Severe storms occurred on the 20th and 24th, the maximum wind velocity reaching 46 miles in the latter storm. The storm of the 29th was probably the worst August storm for years. Although the loss of life and property in this section did not approach that in the Southern States, many thousand dollars' worth of damage was done in New England and the northeast. The rainfall was moderate, but the wind was very severe, the extreme velocity being 75 miles at Boston at 4.12 P.M.

The temperature for the month showed an excess of from 1.1° to 1.7°. Precipitation was considerably above normal in the eastern portions of the State and nearly as much below in the western. The prevailing wind direction was southwest. Light frosts occurred at Great Barrington on the 14th and at Adams on the 23d and 31st. Hail fell at Fitchburg and Concord on the 7th.

The month of September had a temperature considerably below the normal and the precipitation was also deficient.

There were seven cyclones and nine anti-cyclones. The storms were not severe, with the possible exception of the thunderstorm of the 7th. The storm of the 29th was accompanied by light snow in the Berkshire Hills. Rain fell at the same time and the snow melted in a very short time. The last part of the month was unsettled, but no general storms occurred. The prevailing wind direction was westerly. There were light frosts at Concord and Fitchburg on the 3d, and killing frosts at Amherst on the 27th, 28th and 29th.

The temperature during the month of October was above the normal in all portions of the State. The frosts were not as severe as usual during October and held off remarkably; the first killing frost did not occur until the morning of the 17th. The precipitation was about normal or slightly above in western and central Massachusetts, but a deficiency was generally reported throughout the eastern district. Wells and streams were very low during the first twenty days of the month, but the copious rains of the 23d, 24th, 27th and 28th relieved the drought to some extent. With one exception the storms of the month were not severe, and were of short duration, as the number of rainy days will show. The storm of the 14th was accompanied by high southerly gales, but no great amount of damage was done. At Boston the wind attained a velocity of 49 miles from the south during that storm. The amount of cloudiness during the month was much below normal; sixteen days were practically cloudless at the Boston station.

November was dry, with the temperature slightly above the normal in the eastern part of the State and below in the western part. The highest temperature occurred on the 2d or 3d, generally on the latter date, and varied from 57° at Monroe, in the northwestern part of the State, to 72° at Vineyard Haven, in the southeastern part. The lowest was on the 27th, and varied from 4° above zero at Monroe to 27° above at Nantucket. Thus the range for the month was unusually large. The precipitation was from 1½ to 2½ inches below the average for the month in other years. It was well distributed and came in light amounts throughout the month. The first snow of any amount occurred in central and western Massachusetts on the 4th. The fall ranged from 1 to 3 inches, but soon melted. It was general on the 15th, and light falls were reported on the 20th and 22d in some places. The greatest amount reported during the month was 14 inches at Monroe. In the hill districts from a trace to 3 inches of snow lay on the ground on the 15th, but there was practically none in any locality at the end of the month. No report was received of injury to trees or roots by the cold weather. Southwesterly winds prevailed except along the immediate coast. The highest velocity was generally on the 28th, when 72 miles an hour was recorded at Blue Hill Observatory.

December was wet and slightly cooler than the average. The highest temperature occurred on the 25th, ranging from 47° to 61°. The lowest was on the 14th, and was from 10° above zero on the extreme southern coast to 18° below in the interior; making a monthly range even greater than was experienced in November. The 4th was quite warm along the coast, but generally the 25th was one of the warmest Christmas days on record. At Taunton buttercups and pansies were picked in the open air. The precipitation was greatest in the eastern part of the State, but was everywhere above the average. From 8 to 20 inches of snow fell along the coast and from 20 to 35 inches in the hill districts. Except in sheltered places very little remained on the ground after the 25th of the month. Very few reports of probable damage by lack of snow covering were received. Considerable damage was done to fruit trees in eastern Massachusetts by the ice storms of the 3d and 14th to 16th.

## Crops of the Year.

June 1, most correspondents stated that the season was two weeks later than the previous year, but aside from its lateness it was thought to compare favorably with former years. Stock generally wintered well. The bloom for apple trees appeared to be below the average, but other fruit trees and early berries had an unusually full bloom. Insects, particularly the tent-caterpillar, did not appear to be as numerous as usual. The average prices paid farm help appeared to be $20 per month with board and $35 per month without board, while for day help $1.50 per day seemed to be the ruling price.

The first of July the acreage of Indian corn was reported as practically the same as in former years, and though backward it was of good color, and otherwise looking well. Haying had just begun and the crop did not promise to be more than an average, because of drought in the early summer. Early potatoes had about the usual acreage and were generally reported to be looking well, though somewhat backward. Early-market garden crops made average yields with good prices. Dairy products were about average in quantity, with perhaps a slight change for the better in price. Pastures were generally reported to be in good condition. The general outlook for fruits and berries seemed to be good, though there was much complaint of apples not being up to the average. No insects were reported as doing an unusual amount of damage.

Correspondents reported August 1 that there had been little serious damage to crops from insects during the month. Corn promised to be a good crop, for though late it was growing fast. On the whole an average crop of hay was reported as secured in excellent condition, the weather having been favorable for harvesting and the quality first class. Early potatoes were a light crop, with the ruling price $1 per bushel. Late potatoes promised well, but were badly in need of rain. Market-garden crops were generally reported to be about average in yield and price, though Arlington reported small and inferior crops and low prices. Peaches promised well, pears fair and apples poorly. Berries generally yielded well. The majority of returns stated that pastures were suffering from drought, though the condition varied greatly in different localities. Rye was rather better than an average crop.

September 1, the damage from insects during August was reported to have been almost a minimum. Pasturage was below average condition, especially in the western portions of the State, owing to the long-continued drought.

Rowen also suffered severely, the rains coming too late to help it materially. Early fruits, with the exception of apples, were a fair crop and late ones promised well until the severe storms of the latter part of August. Apples were a very short crop at best and at the close of the month appeared to be nearly a total failure. Potatoes suffered severely from drought and hardly promised an average crop. The yield of market-garden crops was only fair but later ones promised to be better. Corn was much damaged by the high winds and an average crop was scarcely expected. Barley and oats were full average crops, oats doing particularly well. Tobacco suffered severely from drought both in yield and quality, and it was thought that the crop would fall short of that of 1892 in all respects. In general the month was not a favorable one.

Indian corn was severely injured by the gales of August, and the returns of October 1 did not show over a three-fourths crop on the average. Rowen suffered severely from drought and was far from being an average crop, generally ranging from light to very light. Fall feed was much improved but was hardly in average condition. Fully the average amount of fall seeding had been done and was in good condition. Stable manure seemed to be the main reliance in fall seeding. Onions were hardly an average crop, having suffered from drought and the attacks of maggots. Potatoes, except in Barnstable County, were below an average yield, but the quality was generally reported good, and only five complaints of rot were received. Root crops generally promised well, most correspondents speaking of the prospect as good or excellent. The apple crop was very light in all sections, and in many localities proved a total failure. The drop of the early season and the severe gales of August were the principal causes of failure. Cranberries were a full average crop, and possibly a little above average, the correspondent for Barnstable referring to the crop as the largest ever harvested.

November 1, seventy-five correspondents reported root crops to have been an average or more than average, and twenty-six less than average. Nearly three-fourths of the correspondents spoke of farm stock as being in either average, good or excellent condition. The returns of correspondents indicated that in all but a very few localities concentrated commercial feed stuffs were relied upon to help out the fodder ration of the dairy stock. The general practice seemed to be to use corn meal, bran, shorts or middlings, or a combination of two or more of these in conjunction with cotton-seed meal, gluten meal, linseed meal or gluten feed. Fall seeding was reported as in good condition generally. Fifty-seven correspondents reported hay to have been among the most profitable crops; thirty-five, potatoes; nineteen, corn; six, cabbage; four, onions; four, oats; three, rye; three, tobacco. Thirty correspondents reported apples as among the least profitable crops; twenty-six, potatoes; twenty-five, corn; five, cranberries; four, tobacco; four, squashes; four, cabbage; three, onions; three, rowen. There was quite general complaint that the season had not been an average one for profit. The majority of correspondents reported the season to have been either a poor one or one not up to the average. Very few referred to it as more than an average.

## Massachusetts Crop Reports.

The publication of monthly crop bulletins was continued as in previous seasons, and six in all were issued (May–October), aggregating 148 pages of printed matter. Two thousand copies of each issue were distributed. The bulletins were made up as in the season of 1892. The only special subject treated was: "Numbers and values of farm animals on farms and ranches, January, 1893," in Bulletin No. 1.

Also, as in 1892, this office co-operated with the New England Weather Service in the issuing of weekly weather-crop bulletins. The first was of date of May 9 and the last of date of September 26, twenty-one in all, representing an aggregate issue of 42,000 copies.

## PUBLICATIONS.

The following publications were issued under the supervision of this office during the calendar year 1893 : —

| | Pages. | Number. | Date of Issue. |
|---|---|---|---|
| Agriculture of Massachusetts, 1892, . . | 842* | 15,000 | Mar. 27. |
| Crop Bulletin, No. 1, May, . . . . . | 28 | 2,000 | June 8. |
| " " No. 2, June, . . . . . | 24 | 2,000 | July 8. |
| " " No. 3, July, . . . . . | 28 | 2,000 | Aug. 5. |
| " " No. 4, August, . . . | 24 | 2,000 | Sept. 9. |
| " " No. 5, September, . . . | 24 | 2,000 | Oct. 9. |
| " " No. 6, October, . . . | 24 | 2,000 | Nov. 9. |
| Catalogue of Abandoned or Partially Abandoned Farms, fourth edition, . . | 128 | 2,000 | Nov. 5. |
| Analytical and Synoptical Index to the Agriculture of Massachusetts, . . . | 301 | 5,000 | Dec. 12. |
| Regulations of Board, Speakers and Subjects, Farmers' Institutes, . . . . | 8 | 300 | Dec. 26. |

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* Including Annual Report of Director of State Agricultural Experiment Station, 354 pages.

## LEGISLATION.

The legislation of the year 1893 that had reference to the Board of Agriculture or to the agricultural societies was: " An Act to establish the salary of the second clerk of the secretary of the State Board of Agriculture " (Acts of 1893, chapter 130) ; a " Resolve providing for the collection and circulation of information relating to abandoned farms " (Resolves of 1893, chapter 46) ; a " Resolve providing for the printing of the special report of the State Board of Agriculture on the work of extermination of the *Ocneria dispar* or gypsy moth " (Resolves of 1893, chapter 15) ; a " Resolve providing for the printing and distribution of a synoptical and analytical index to the annual volumes of the Agriculture of Massachusetts " (Resolves of 1893, chapter 25) ; a " Resolve providing against depredations by the insect known as the *Ocneria dispar* or gypsy moth " (Resolves of 1893, chapter 40) ; " Resolutions concerning the extermination of the gypsy moth."

## APPROPRIATIONS.

| OBJECTS FOR WHICH APPROPRIATED. | 1891. | | 1892. | | 1893. | | 1894. |
|---|---|---|---|---|---|---|---|
| | Appropriated. | Used. | Appropriated. | Used. | Appropriated. | Used. | Appropriated. |
| Bounties to societies, | $21,000 00 | $20,338 65 | $21,500 00 | $21,352 49 | $21,000 00 | $20,982 45 | $21,000 00 |
| Travelling and necessary expenses of the Board, | 1,900 00 | 1,779 11 | 1,900 00 | 1,516 39 | 1,900 00 | 1,630 77 | 1,900 00 |
| Travelling and necessary expenses of the secretary, | 500 00 | 500 00 | 500 00 | 500 00 | 500 00 | 459 22 | 500 00 |
| Incidentals in office of secretary, | 500 00 | 500 00 | 500 00 | 500 00 | 600 00 | 600 00 | 700 00 |
| Salaries of secretary and clerks, | 4,205 55 | 4,205 55 | 5,100 00 | 5,100 00 | 5,300 00 | 5,300 00 | 5,300 00 |
| Dissemination of useful information in agriculture by means of lectures or otherwise, | 2,200 00 | 2,200 00 | 2,200 00 | 2,148 06 | 2,550 00 | 2,550 00 | 2,650 00 |
| Printing 15,000 copies of the "Agriculture of Massachusetts," | 5,974 00 | 5,974 00 | 5,897 58 | 5,897 58 | 6,052 26 | 6,052 26 | *6,000 00 |
| Collecting and circulating information relative to abandoned farms, | 2,000 00 | 676 62 | †1,323 38 | 164 88 | 1,000 00 | 280 78 | †719 22 |
| Carrying forward work of Dairy Bureau, | 4,000 00 | 903 05 | 4,000 00 | 3,427 51 | 4,000 00 | 3,336 90 | 4,000 00 |
| Salary of executive officer of Dairy Bureau, | 166 67 | 166 67 | 500 00 | 500 00 | 500 00 | 500 00 | 500 00 |
| Salary of assistant in work of Dairy Bureau, | 390 00 | 390 00 | 1,200 00 | 1,200 00 | 1,200 00 | 1,200 00 | 1,200 00 |
| Nails or spikes for marking shade trees for preservation, | 100 00 | 62 69 | 100 00 | 48 42 | 100 00 | 100 00 | 100 00 |
| Printing 5,000 copies synoptical and analytical index to the "Agriculture of Massachusetts," | - | - | - | - | 1,400 00 | 1,400 00 | ‡393 36 |
| Aggregates, | $42,936 22 | $37,696 34 | $44,720 96 | $42,355 33 | $46,102 26 | $44,392 38 | $44,962 58 |

* Estimated. † Balance. ‡ Deficiency.

Also, $100,000 was appropriated to be used in the extermination of the gypsy moth. An appropriation of $165,000 for this work has been asked of the Legislature of 1894.

### NAILS FOR MARKING TREES.

The work of supplying nails or spikes for the marking for preservation of shade trees within the limits of highways, under the provisions of chapter 196 of the Acts of 1890 (see page 429 of this volume), has been continued. The annual appropriation of $100 for the supplying of these nails has become insufficient and probably will have to be increased another year. Nails in varying quantities have been supplied, on application, to the cities of Marlborough and Worcester, and the towns of Acton, Barre, Beverly, Boxford, Carlisle, Falmouth, Framingham, Goshen, Hardwick, Littleton, Pepperell, Petersham, Wakefield, Westfield, Westford and Winchendon. Since the work of supplying nails was begun, Dec. 26, 1891, 2 cities and 32 towns have availed themselves of the provisions of the act.

### GYPSY MOTH. (*Ocneria dispar.*)

The Legislature of 1893 appropriated $100,000 for the continuation of the work of exterminating this pest and the report of the committee in charge will be found printed on pages 262–302 of this volume. At the annual meeting Feb. 8, 1894, the following committee was elected to have charge of the work of the present year: Messrs. E. W. Wood of West Newton, Francis H. Appleton of Lynnfield, Wm. H. Bowker of Boston, Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury and the Secretary.

### DAIRY BUREAU.

No change has taken place in the *personnel* of the Dairy Bureau. Their annual report to the Legislature (Senate Document No. 8) will be found printed on pages 237–261 of this volume.

### AGRICULTURAL COLLEGE.

The report of the examining committee of the Agricultural College will be found printed on pages 352–353 of this volume.

### RETURNS OF SOCIETIES.

These returns will be found printed on pages 305–335 of this volume. A summary is printed on page 335, contrasting the totals of 1891, 1892 and 1893.

### FARMERS' INSTITUTES.

The societies held one hundred and thirty-five institutes in 1893. The places, dates and subjects will be found printed in the returns of the societies. A provision of law enables this office to furnish speakers for institutes. During the year 1893 this office furnished speakers for eighty-four at an expense of $1,097.17, an average of $13.06. For 1892 the number was seventy-eight, at an expense of $662.39, an average of $8.49. The increased expense was due to the employment of several specialists from outside the State. In December, 1893, a pamphlet was prepared by this office, for the use of officers of societies and institute committees, containing the regulations of the Board of Agriculture concerning the holding of farmers' institutes by the several societies, with a list of available speakers and their subjects.

### ABANDONED FARMS.

The act authorizing the State Board of Agriculture to collect and circulate information relating to abandoned farms was approved May 4, 1891.

A summary of the work of this office to date shows the following results: Number of abandoned or partially abandoned farms reported to this office, 998; number of owners or agents making reply to our inquiries, 678; number of descriptions of property received, 400; number of owners or agents not desiring to advertise in catalogue, 98; number of owners or agents reporting farm sold in reply to our request for description, 42; number of owners or agents reporting assessors or others to have been misinformed about the property, 76; letters returned by post-office department as unclaimed, 64.

The circulation of the first edition (3,000 copies) of the descriptive catalogue of abandoned or partially abandoned farms began Dec. 5, 1891. Requests for the catalogue came from nearly every State in the Union, and within two months the entire edition was exhausted. About one-third of the edition was sent to owners or agents of the property described, to assessors, to members of the Board of Agriculture and to officers of agricultural societies. The remainder were sent or given only upon request.

The circulation of a second edition of 1,500 copies of the catalogue began Feb. 1, 1892. Nine new descriptions were included in this edition, making a total of 339. Requests for the catalogue were received from time to time, until by the middle of September the edition became exhausted. The distribution of this edition was very largely through requests by mail and at the office.

In order to supply the demand for the catalogues it became necessary to prepare a third edition, and the issue of 2,000 copies of this began Nov. 26, 1892. The distribution was made through request only, and by the first of October, 1893, the supply was totally exhausted.

It having been decided to print a fourth edition, notice was sent the last of September to each person having a description in the catalogue with the request for a statement if the farm had been sold; and if it had not been sold if it was desired to continue the description in another edition of the catalogue. This request was in some instances made three times. Up to November 17, returns were received concerning 349 of the 383 farms described in the third edition. Of these, 108 were reported sold; 53 owners wished to have the description withdrawn, and 189 owners wished description continued in the fourth edition. Nothing was heard concerning 33 farms. Of the 108 farms reported sold, 15 are in Berkshire County, 3 in Bristol County, 1 in Essex County, 13 in Franklin County, 10 in Hampshire County, 11 in Hampden County, 6 in Middlesex County, 1 in Nantucket County, 6 in Norfolk County, 10 in Plymouth County, and 32 in Worcester County. Of the 53 farms withdrawn, 1 is in Barnstable County, 7 in Berkshire County, 1 in Bristol County, 1 in Dukes County, 6 in Franklin County, 4 in Hampden County, 8 in Hampshire County, 3 in Middlesex County, 2 in Norfolk County, 4 in Plymouth County and 16 in Worcester County. Several who wished description withdrawn stated that they expected to sell the farm at an early date, and therefore did not wish the description continued, while several others stated that they either expected to occupy the farm themselves or to have it occupied by some member of their family.

It was noticed that a large majority of the purchasers of the farms sold were of American parentage. Sixty-six purchasers were residents of Massachusetts at the time of purchasing, 4 of Connecticut, 2 of New Jersey, 1 of New York, 1 of New Hampshire, 1 of Rhode Island, 1 of Ohio, 1 of Nova Scotia, 1 of Illinois, 1 of Florida, while the residences of 29 were not reported. Forty-four of the farms sold were reported as sold for farming purposes, 3 for farming purposes and poultry raising, 4 for poultry raising, 1 for poultry raising and market gardening, 2 for sheep raising, 4 for summer residences, 9 for homes, 3 for the timber on them, 5 as investments, while the intentions of 33 purchasers were not obtained. Seventeen additional descriptions were received and incorporated as an additional addenda, making the total number of farms described 400.

By the State census of 1885 there were 45,010 farms in the State, representing a total acreage of 3,898,429¼; average acreage, 86.61; total value of lands and buildings, $185,188,925; and average value of land and buildings, $4,112.83. The total acreage of the 400 farms advertised in the catalogue is 44,268½; average acreage, 110.67; total amount asked for the farms, $659,975, and average amount asked for the farms $1,649.94. The total acreage of the 108 farms reported sold is 10,324, or an average acreage of 95.51. The 108 farms sold for a total of $175,300, or an average of $1,623.15. One farm sold for $250, 1 for $300, 2 for $325 each, 3 for $400 each, 2 for $450 each, 4 for $500 each, 7 for $2,000 each, 2 for $2,200 each, 3 for $2,500 each, 1 for $2,700, 1 for $2,750, 5 for $3,000 each, 2 for $3,500 each, 1 for $3,600, 1 for $4,100, 2 for $4,500 each, 1 for $4,600, 1 for $4,800, 2 for $5,000 each, 1 for $6,000, while the prices of the remainder ranged from $500 to $1,800. In size, 1 was a farm of 4 acres, 1 of 6 acres, 1 of 7 acres, 1 of 10 acres, 1 of 11 acres, 1 of 15 acres, 2 of 16 acres each, 4 of 200 acres each, 1 of 220 acres, 2 of 225 acres each, 1 of

230 acres, 1 of 250 acres, 1 of 263 acres, 2 of 280 acres each, while the remainder ranged from 18 to 175 acres. Fifty-two were 100 acres or over.

As the appropriation of $2,000 made in 1891 expired by limitation Jan. 1, 1893, a further appropriation of $1,000 was asked of the Legislature of 1893 for the continuation of this work and freely granted; $280.78 only of this appropriation has as yet been used. The only expenses incurred in this work have been for printing and postage, and the total cost of the 8,500 copies of the catalogue (four editions) has been $1,422.28.

Two thousand copies of the fourth edition were issued Nov. 5, 1893, and 1,000 copies remain undistributed.

It is, of course, difficult to determine just what advantages will result, but it is believed quite generally that this effort to secure the reoccupancy of our abandoned or partially abandoned farms has met not only with an appreciative reception, but that the results will be to the advantage of the State.

## Scales of Points.

The Board, at the annual meeting of 1893, voted "That in awarding premiums, especially on live stock, vegetables and fruits, there shall be established by this Board a scale of points, which shall be adopted by all the societies, so that there shall be a uniform standard throughout the State;" also "That in the judging of all live stock, vegetables and fruit each society shall employ an expert or experts." The executive committee took hold of the matter and scales of points for judging vegetables (illustrated by cuts of types), fruits, horses, sheep, swine, poultry and Aberdeen-Angus, Ayrshire, Devon, Dutch Belted, Guernsey, Hereford, Holstein-Friesian, Jersey and Shorthorn cattle were prepared and furnished the several societies for use at their fairs of 1893. It is believed that Massachusetts has taken the lead in this matter and that no other State Board of Agriculture has similar requirements.

A lecture on "Judging animals by scale of points" was delivered by Dr. Geo. M. Twitchell of Augusta, Me., at the public winter meeting of the Board at Great Barrington.

It was followed by profitable discussion, a horse being brought upon the platform and scored by the doctor in the presence of the audience. The lecture and discussion following will be found printed on pages 90–114 of this volume. Dr. Twitchell has also presented this subject to several societies at institutes this winter and also has engagements for the future.

## Agricultural Directory.

A directory of the agricultural organizations of the Commonwealth, with officers for 1894, has been prepared, and will be found printed on pages 399–413 of this volume.

## Library.

The library in the office has increased very rapidly the past few years through exchange and by purchase. The library is essentially a reference library and is of great use to the office. The secretary, under an order of the Board, has appointed his first clerk, Mr. F. H. Fowler, librarian and curator, and a determined effort will be made the present year to thoroughly overhaul, classify and catalogue the many valuable books and pamphlets in order that they may become readily accessible and consequently much more valuable for reference.

## Analytical and Synoptical Index.

The Legislature of 1893 passed a resolve authorizing the secretary of the Board of Agriculture to "cause to be electrotyped, printed and bound for distribution, five thousand copies of a synoptical and analytical index to the fifty-two annual volumes of the 'Agriculture of Massachusetts.'" In accordance with this resolve, an index of 301 pages was prepared by Mr. F. H. Fowler, first clerk in the office, after months of close and continuous application. It was prepared for the convenience of officers and librarians of agricultural institutions and organizations, and particularly for those who have preserved a full set of the volumes indexed. The first copies of the index were received from the printers in December, 1893.

## Meetings of the Board.

The public winter meeting of the Board for lectures and discussions was held at Great Barrington, Dec. 5, 6 and 7, 1893. The attendance was unusually large and the meeting was in all respects a good one. The lectures and discussions will be found printed on pages 28–194 of this volume. A special business meeting of the Board was held at Great Barrington Dec. 5, 1893, an account of which will be found printed on pages 11–19. The annual meeting of the Board for the transaction of business was held at the office of the secretary, Feb. 6, 7 and 8, 1894, and the minutes thereof, reports adopted and essays read will be found printed on pages 339–395 of this volume.

## Organization of the Board.

At the annual meeting of 1894 the Board adopted a new set of by-laws, regulations and recommendations, and resolved itself into eight standing committees. Six specialists were also elected. The full text of the by-laws, etc., with the statute laws governing the Board of Agriculture and the agricultural societies, will be found printed on pages 421–455 of this volume. The roster of the Board and its committees for 1894 will be found printed on pages 399–400 of this volume.

## Changes in the Board.

During the past year the following changes have taken place in the *personnel* of the Board: His Excellency Wm. E. Russell, a member *ex officio* for three years, ceased to be governor and consequently a member of the Board of Agriculture. Prof. N. S. Shaler of the Martha's Vineyard Society, after five years of service, resigned on account of press of other public duties. Messrs. J. D. W. French of the Bay State Society, Henry S. Russell of the Massachusetts Society for Promoting Agriculture and W. W. Rawson of the Middlesex Society retired because their societies had ceased to comply with the conditions for representation on the Board made necessary by the statutes, — Mr. French after one year of service, Mr. Russell after two years of service, and Mr. Rawson after six years of service. The following gentlemen retired from the Board because of the expiration of their term of service: Elbridge Cushman of Lakeville, an appointee of the governor, after three years of service; Chas. A. Mills of the Berkshire Society, after three years of service; Dr. Wm. Holbrook of the Eastern Hampden Society, after six years of service; C. F. Fowler of the Hampden Society, after three years of service; E. C. Clapp of the Hampshire, Franklin and Hampden Society, after three years of service; A. J. Bucklin of the Hoosac Valley Society, after three years of service; J. H. Rowley of the Housatonic Society, after six years of service; L. S. Richards of the Marshfield Society, after three years of service; and Wm. W. McIntosh of the Nantucket Society, after one year of service. Death claimed no members during the year.

## Cattle Commissioners.

The annual report of the State Board of Cattle Commissioners, including a paper on "Tuberculosis in Cattle," by the secretary, Charles P. Lyman, F.R.C.V.S., will be found printed on pages 195–235 of this volume.

## Farmers' Congress.

A report of the National Farmers' Congress at Savannah, Ga., Dec. 12–14, 1893, by Hon. Daniel Needham, Delegate at Large, will be found printed on pages 414–418 of this volume.

WM. R. SESSIONS,
*Secretary of the State Board of Agriculture.*

Boston, March, 1894.

# MEETINGS OF THE EXECUTIVE COMMITTEE

OF THE

# BOARD OF AGRICULTURE.

1893.

# MEETINGS OF THE EXECUTIVE COMMITTEE OF THE BOARD.

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BOSTON, March 23, 1893.

*Voted*, To grant the requests of the Housatonic and Eastern Hampden Agricultural Societies to be excused from employing experts to judge live stock, fruits and vegetables at their fairs in the year 1893, on the ground that judges had been appointed and lists of premiums and names of judges had been printed before the annual meeting of the Board.

*Voted*, That the secretary be instructed to communicate with Hon. John E. Russell, former secretary of the Board, requesting his portrait to be hung in the office of the Board.

*Voted*, That the matter of a scale of points for judging fruits be referred to Mr. E. W. Wood, with instructions to secure the assistance of two experts in making up a scale; and that the matter of a scale of points for judging vegetables be referred to Mr. W. W. Rawson, with instructions to secure the assistance of two experts in making up a scale, for use by the several incorporated agricultural societies in judging and awarding premiums; and that Messrs. Wood and Rawson report the result of their work to the executive committee at a future meeting.

*Voted*, That the secretary be instructed to prepare a statement of the cases of the Massachusetts, the Bay State, and the Middlesex Societies, and request the Governor or the Secretary of the Commonwealth to ask the opinion of the Attorney-General as to the right of these societies, under the law, to representation on the Board of Agriculture. The secretary to report to the executive committee at a future meeting.

*Voted*, That Mr. Francis H. Appleton be requested to prepare a bill embodying his ideas of the changes that should be made in the law regulating the distribution of the State bounty to the incorporated societies.

*Voted*, That the secretary correspond with the secretaries of the several societies and ascertain what subjects the societies would like to have discussed by the speakers in the circuit of institutes for 1894; also the speakers desired by the several societies.

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Boston, June 8, 1893.

*Voted*, That the executive committee decline to grant the petition of the Barnstable County Agricultural Society to be excused from employing experts as judges at the 1893 fair of the society on account of expense to the society. The committee believes that the expense incurred need not be large, as the rule of the Board does not forbid the employment of experts within the limits of the society.

Mr. Wood, for the committee to whom was referred the matter of a scale of points for judging fruits, reported a scale of points; which was adopted by the committee.

*Voted*, That the secretary make a list of men suitable to act as experts in the different classes in which the Board requires experts, including the names suggested by the members of the Board, with such additions as may be suggested by the members of the executive committee, and send a copy of the list, when completed, to the secretaries of the several societies.

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Boston, June 15, 1893.

Mr. Rawson, for the committee on scale of points for judging vegetables, reported that he was not ready to submit a copy of the report.

*Voted*, That the committee have further time, and that it is hereby instructed to present the secretary with a copy of the proposed scale of points for vegetables, with illustrations of the true type of the different kinds, and that the secretary be instructed to submit the same to the members of the executive committee for their approval; which was done, and the scale presented was adopted by the committee.

*Voted*, That the scale of points recommended by the associations of breeders of the different breeds of thoroughbred cattle be adopted by the committee, and that the scale of points for Shorthorns and Herefords recommended by the New York State Agricultural Society in 1861 be adopted for those breeds.

*Voted*, That the scale of points for judging horses used by Dr. Geo. M. Twitchell of Maine be adopted by the committee.

Mr. Rawson presented a scale of points for judging swine; which was adopted by the committee.

The secretary presented a scale of points for judging sheep; which was adopted by the committee.

A scale of points for judging poultry was presented.

*Voted*, That no scale of points be established by the Massachusetts State Board of Agriculture, but it is recommended that poultry premiums be awarded in accordance with the American standard of perfection, as adopted by the American Poultry Association, George E. Peer, secretary, Rochester, N. Y., and that societies not having access to the above-named standard may use the scale of points presented to the committee.

*Voted*, That the secretary be instructed to notify the secretaries of the several agricultural societies that they are excused from employing experts for judges in all classes for which a scale of points is not provided by the executive committee.

*Voted*, That the chairman be instructed to report to the Board on the matter of the order of colors to be used in designating premiums in accordance with the facts that appear from the correspondence with other State boards and societies.

BOSTON, June 27, 1893.

The executive committee this day excused the Union Agricultural and Horticultural Society, on its request, from employing experts as judges in the several classes at the fair of the society for the year 1893, the reason for the excuse being that the society had appointed the judges at its annual meeting in December and had printed a list of such judges in the society's transactions previous to the annual meeting of the Board at which the rule requiring the employment of expert judges was adopted.

BOSTON, Sept. 13, 1893.

The executive committee this day excused the Middlesex North Agricultural Society from employing experts as judges at the fair of the society for the year 1893, for the same reason that the Union Agricultural Society was excused on June 27, 1893.

BOSTON, Oct. 5, 1893.

The executive committee this day appointed the secretary of the Board of Agriculture delegate of the Board to the agricultural congresses of the World's Columbian Exposition at Chicago during the week beginning Oct. 16, 1893.

GREAT BARRINGTON, Dec. 5, 1893.

*Voted*, That Mr. William Bancroft, at his request, be excused from preparing an essay on "Sheep on our Western Hills" for the next annual meeting of the Board, and that he prepare an essay, instead, upon "The Pleasures of Farming."

BOSTON, Dec. 15, 1893.

*Voted*, To refer the reports of the delegates to the fairs of the agricultural societies to the secretary, that he may examine them and prepare an abstract containing the essential points to be presented to the annual meeting, as was done last year.

*Voted*, That the secretaries of societies be required to certify to the holding of the three institutes required by the Board each year on blanks to be furnished by the secretary.

To aid in carrying out the spirit of former requirements of the Board in relation to institutes, the executive committee instructed the secretary to print in pamphlet form the requirements of the Board relative to the holding of institutes, and include therewith a list of speakers and subjects available for institute work, and send copies to officers of societies and institute committees, with the request that they select subjects, speakers and dates for the three institutes required by the Board, and notify the secretary of the Board as early as possible, that he may have sufficient time to arrange with the speakers chosen.

# SPECIAL MEETING

OF THE

# BOARD OF AGRICULTURE,

AT

# GREAT BARRINGTON.

December 5, 1893.

# SPECIAL MEETING OF THE BOARD OF AGRICULTURE AT GREAT BARRINGTON.

GREAT BARRINGTON, MASS., Dec. 5, 1893.

The Board of Agriculture met at the town hall, Great Barrington, Tuesday, Dec. 5, 1893, at 9.50 o'clock in the forenoon, in conformity with the vote of adjournment at the last annual meeting, with the exception that the Board met in the forenoon instead of in the evening. The Board was called to order by Hon. James S. Grinnell, who presided.

Present: Messrs. Appleton, Bancroft, Barton, Bursley, Cook, Cruickshanks, Damon, French, Goodell, Grinnell, Harwood, Hartshorn, Hersey, Newhall, Pratt, Reed, G. C. Rowley, J. H. Rowley, Sargent, Shaw, Ward, Warren, West and Wood.

The secretary read from the proceedings of the last annual meeting, and suggested that the executive committee report upon the standing of the Bay State Agricultural Society and other societies.

Mr. WOOD, chairman of the executive committee, read the statement of facts upon which the opinion of the Attorney-General was based, and also the opinion itself.

President H. H. GOODELL moved that the legislative committee be instructed to petition the Legislature for such a provision of law as will enable the Massachusetts Society for Promoting Agriculture to be represented on the Board.

Mr. HERSEY seconded the motion, spoke of the early work of the Massachusetts Society in the formation of agricultural clubs and societies, and referred particularly to the formation of a farmers' club in Hingham in 1814, with sixteen members, that continued to hold meetings until 1830, stating that the records of this club and a copy of the circular sent out by the Massachusetts Society are deposited in the library of the Hingham Society. Mr. HERSEY also spoke of the present work of the society.

Mr. GRINNELL said that, judging by his knowledge of the work of the society, no agency had done more for the promotion of agriculture.

The motion of President GOODELL was then put and unanimously carried.

Mr. APPLETON, one of the trustees of the society, presented the thanks of the society, informally, for this action and expression of good will.

On motion of Mr. HERSEY —

*Voted*, That the opinion of the Attorney-General be accepted and spread upon the records, and also that a copy be sent in pamphlet form to each society as a guide for future reference.

The secretary made personal application to the Governor to obtain the opinion of the Attorney-General, which he kindly consented to do, and the following statement of facts was furnished by the secretary for the use of the Attorney-General in forming an opinion : —

## STATEMENT OF FACTS.

At the annual meeting of the State Board of Agriculture, Feb. 1, 1893, it was —

*Voted*, That the executive committee be instructed to investigate the standing of the Bay State Agricultural Society and other societies, and report at the next public winter meeting; and that the committee be authorized and instructed to take proper means to get the opinion of the Attorney-General in the matter.

The law providing who shall constitute the Board of Agriculture is Public Statutes, chapter 20. The law regulating the payment of bounty to agricultural societies is Public Statutes, chapter 114.

The Massachusetts Society for Promoting Agriculture has had a representative on the Board of Agriculture ever since its organization in 1852. The society received State bounty continuously until and including the year 1860, when it voluntarily relinquished it, on the ground of the excessive expenditures caused by the war of the rebellion. The society has not received State bounty since 1860, and has held no fairs or exhibitions since that date. The society reported its transactions to the Board of Agriculture each year until and including 1879, and reported the amount of its permanent fund or capital stock until and including 1882. Since 1882 no returns or transactions have been rendered to the Board of Agriculture. In the year 1866 the Legislature (chapter 189, section 2, Acts of 1866) provided that "Any agricultural society publishing its transactions and making its returns to the secretary of the Board of Agriculture as provided in chapter 66, section 5, of the General Statutes, should be entitled to a delegate to said Board under the provisions of chapter 16 of the General Statutes." . . . Said section 2 of chapter 189, Acts of 1866, was repealed by chapter 128, Acts of 1869.

The Bay State Agricultural Society held its first fair in 1886. It held no fair in 1887, and first made return to the State Board of Agriculture for the year 1888, stating its capital stock or money invested to be $2,177.16. It held a fair that year at Springfield. The society made returns for the year 1889 and received bounty to the amount of $400, predicated on the fair of 1888. It held a fair in 1889 in Boston. The society made returns for the year 1890. It held no fair that year, but received bounty to the amount of $600, predicated on the fair of 1889. Made returns for the year 1891, but held no fair and received no bounty. The society made returns for the year 1892, but held no fair and received no bounty. The society elected a delegate to the Board for the year 1887, and has been represented on the Board since that year.

The Middlesex Agricultural Society is one of the oldest societies and was among those that were represented at the organization of the Board of Agriculture, having the requisite capital stock and having had a delegate on the Board ever since. It has held fairs annually and received bounty until 1889, when it held no fair, but received bounty predicated on the fair of 1888. It held no fair in 1890 and received no bounty. In the year 1891 it held a fair, but received no bounty. In the year 1892 it held no fair, but received bounty predicated on the fair of 1891. The Middlesex Society has made annual returns to the present time.

The Bay State Agricultural Society was incorporated in 1886.

| | |
|---|---|
| This society had originally (1888) invested as capital stock, | $2,177 16 |
| This society had in January, 1893, invested as capital stock, | 343 48 |

The Middlesex Agricultural Society was incorporated in 1803.

| | |
|---|---|
| This society had originally (1853) invested as capital stock, | $3,000 00 |
| This society had in January, 1893, invested as capital stock, | – |

The Hampden Agricultural Society was incorporated in 1844.

| | |
|---|---|
| This society had originally (1853) invested as capital stock, | $4,860 00 |
| This society had in January, 1893, invested as capital stock, | 794 79 |

The Hampshire Agricultural Society was incorporated in 1814.

| | |
|---|---|
| This society had originally (1853) invested as capital stock, | $3.255 26 |
| This society had in January, 1893, invested as capital stock, | 2,650 00 |

The Hampshire, Franklin and Hampden Agricultural Society was incorporated in 1818.

| | |
|---|---|
| This society had originally (1853) invested as capital stock, | $8,141 29 |
| This society had in January, 1893, invested as capital stock, | 1,877 20 |

The Highland Agricultural Society was incorporated in 1859.

| | |
|---|---|
| This society had originally (1853) invested as capital stock, | $2,262 00 |
| This society had in January, 1893, invested as capital stock, | 1,100 00 |

## LETTER FROM THE GOVERNOR TRANSMITTING THE OPINION OF THE ATTORNEY-GENERAL.

BOSTON, Oct. 4, 1893.

Hon. WM. R. SESSIONS,
*Secretary, Board of Agriculture.*

DEAR SIR: — I have received from the Attorney-General his opinion on the questions recently submitted by me to him as to the status of certain agricultural societies and their right to representation on the Board of Agriculture. I enclose a copy of his opinion.

Very truly yours,
[Signed] WM. E. RUSSELL.

## OPINION OF THE ATTORNEY-GENERAL.

SEPT. —, 1893.

*To His Excellency the Governor.*

I have to reply as below to your request for my opinion upon the questions raised in relation to the rights of representation of certain agricultural societies in the Board of Agriculture. The statutes bearing upon the subject are more or less complicated and confused, and are difficult of construction, but upon careful consideration I am satisfied that the conclusions stated below embody the only practicable and intelligible construction which can be put upon them. I will state the matter somewhat more fully than might otherwise be necessary in order, if possible, that the whole case may be fully understood, with a view to any changes in the law which may be thought necessary or desirable. I do not understand that section 11 of chapter 114 of the Public Statutes is material in the case of either of these societies now in question, and I have dealt with the matter only in view of such provisions as seem to be applicable to them upon the statement of facts presented by you, which of course I assume to be correct and sufficiently full for the purpose.

By sections 1 and 6 of chapter 114 of the Public Statutes the right of any society to receive any bounties in a particular year depends upon having awarded and paid the same amount in premiums and complied with all the requirements of law and the regulations of the Board during the preceding year.

The right of any society to representation on the Board in a particular year depends upon its title to receive bounty in that year. Section 2, as now amended, and section 5 require each society to make the proper return, on or before the 10th of January in each year, of the facts which show whether it is or is not entitled to a payment of bounty in the following October; and the theory of the law undoubtedly is that between the 10th of January, when these returns are supposed to be in, and the first Wednesday of February, when new members take their seats in the Board, the title to representation in the Board shall be determined, by and upon the returns.

It thus appears that the right of each society to representation on the Board must be determined at the time when the new members take their seats, on the first Wednesday of February, according to what the society has done or omitted to do during the preceding year, as shown by its returns. And as the provision of section 1, that no society shall receive any larger bounty in any year than it has awarded and paid in premiums during the preceding year, and of section 6, that a society which neglects in any year to comply with the requirements of law or regulations of the Board shall not be entitled to bounty, are expressed in prohibitory language, I think they must be construed as peremptory conditions of representation in the Board, failure to comply with any of which forfeits the right of representation.

The question has been raised whether the application of the bounty or its equivalent, for the general purpose of the encouragement or improvement of agriculture or manufactures, under the permission of section 7, is not an equivalent for the earning of a bounty, so as by itself to entitle a society to representation. I do not think the statute can be so construed. The provision that no society shall receive a larger bounty than it has awarded and paid in premiums during the preceding year was a special enactment by chapter 258 of the Acts of 1870, passed while substantially all the other provisions of the law were and had been in force at least for some years; and this clearly indicates the purpose of the Legislature that the right to bounty shall depend absolutely upon the award and payment of premiums during the preceding year; and, as has already appeared, the right of representation in the Board depends upon the right to bounty. The requirements of section 7, to apply the bounty to the general encouragement or improvement of agriculture or manufactures if it is not offered in premiums, is undoubtedly binding upon every society; but while compliance with it fulfils the obligation of that section, it does not necessarily entitle a society to representation in the Board, as the bounty is not received, and therefore cannot be expended, until October, while the right of the society to representation in that year depends upon its having offered and paid in premiums during the preceding year an amount equivalent to the bounty. In other words, under section 7 a society may apply a bounty either in premiums or to the general encouragement or improvement of agriculture or manufactures; but the latter application of it would not entitle the society to representation in the Board during the succeeding year, while the former application of it would if the other requirements were fulfilled.

The question is raised also whether the requirement of section 1 of chapter 114, of an invested capital of $1,000, is satisfied if a society has ever had and invested a capital equivalent to that amount. Section 1 provides that two classes of societies shall be entitled to bounty while complying with the other requirements, namely, societies which were entitled to bounty before May, 1866, of which $1,000 capital was then as now a condition, and other societies whose grounds are not within twelve miles of any others, which have raised and invested the same capital. As by section 1 the bounty is to a certain extent measured by the capital, and as the reasons for requiring a capital seem to apply alike to all societies, it appears to me that this requirement applies to all. I think the reason of this provision, if not the language, can be satisfied only by an actually existing investment of capital of that amount at the time when the question of the right of the society to representation arises, and that a previous investment of such capital, which has been expended or lost, does not fulfil this requirement, the purpose of which seems clearly to be to require an existing and invested capital of at least $1,000 as a sort of guarantee that the society is doing or is prepared to do some actual work in the cause of agriculture.

I understand also that the question is raised whether a member taking his seat in the Board on the first Wednesday of February, by virtue of what his society has done and returned during the preceding year, is entitled to serve during the full term of three years, or whether his membership may be terminated during that time by the failure of his society to continue entitled to bounty; and that I am desired to express an opinion upon this question. Section 2 of chapter 20 of the Public Statutes provides that persons appointed shall hold their offices for three years, and provides for the filling of vacancies "in the same manner," namely, by the Governor and Council, or by the societies. As the right to bounty in any year depends on what the society has done during the preceding year, and as the right to membership in any year depends upon the title of the society to bounty in that year, and as the title both to bounty and to membership accrues year by year, if it accrues at all, and has to be shown by the returns of the society on or before the 10th of January in each year, I am of the opinion that a society which does not show by its returns on or before January 10 that it is entitled to a payment of bounty in the following October is not entitled to representation in the Board on or after the first Wednesday of February following; and therefore that the membership of a representative of a society which does not show by its returns on or before the 10th of January that it is entitled to a payment of bounty in the following October ceases on the first Wednesday of February following the making of or the omission to make the return; subject, however, to be reinstated within the period of three years, if the society within that time acquires the right to bounty in accordance with the requirements of the law as here stated.

Applying these conclusions to the particular cases now in question, as they appear by the statement of facts furnished me, I am of the opinion that the Massachusetts Society for Promoting Agriculture is not at present entitled to representation in the Board, as it did not offer or pay any premiums last year, nor make any returns as required by law; that the Bay State Agricultural Society and the Middlesex Agricultural Society are not at present entitled to representation, as they awarded and paid no premiums last year, and therefore did not become entitled to receive any bounty this year, and as their returns do not show the requisite capital. As to the Hampden Society, its return fails to show the requisite capital. The returns of the Hampshire, the Hampshire, Franklin and Hampden and the Highland Society show the necessary capital.

This disposes of all the questions raised in any case on the statement of facts before me.

Very respectfully, your obedient servant,

A. E. Pillsbury,

*Attorney-General.*

The secretary called attention to the appointment of a special committee at the last annual meeting to codify the rules and regulations of the Board and all existing by-laws, etc., and read a letter bearing upon the report of the committee, from the chairman, Mr. Bowker, who was detained from the meeting by sickness.

Mr. French of the special committee presented the report of the committee, in print.

Mr. Shaw moved that the report of the committee be accepted and that each article be taken up and considered; which motion was carried.

After the report of the committee had been duly considered and various portions of it had been approved, it was, on the motion of Mr. Goodell —

*Voted*, That the report be referred back to the committee, and that the secretary and Messrs. Wood and Varnum be added to the committee, with instructions to report at the next annual meeting.

The Chairman spoke of the loss of Mr. Yerrinton and of his valuable work as stenographer of the Board, and said that it seemed to him proper that the Board should recognize his decease, and he therefore offered the following resolutions: —

*Resolved*, That in the death of Mr. J. M. W. Yerrinton, the official stenographer of the Board, who has from the first and during the last thirty years reported the proceedings of the Board at the annual public winter meeting with great skill and singular exactness, the community has lost a most valuable citizen and the Board of Agriculture a faithful servant and genial friend, and that his careful, painstaking work has endeared him to every member of this Board.

*Resolved*, That this resolution be spread upon the records of the Board and that a copy be sent by the secretary to the family of Mr. Yerrinton.

Mr. Francis H. Appleton stated that he attended the funeral as a member of the Board of Agriculture.

The secretary spoke of the accuracy and carefulness of Mr. Yerrinton; and the resolutions were unanimously adopted.

*Voted*, To adjourn until after the afternoon discussion.

The Board met after the afternoon discussion, as per adjournment, and the secretary called attention to the time for the adjourned meeting, Tuesday evening, Dec. 5, 1893, as voted at the annual meeting, and at his suggestion the Board voted to ratify the proceedings of the forenoon meeting.

The meeting was then formally adjourned.

# PUBLIC WINTER MEETING

OF THE

# BOARD OF AGRICULTURE,

AT

## GREAT BARRINGTON.

December 5, 6 and 7, 1893.

# PUBLIC WINTER MEETING OF THE BOARD,

## AT GREAT BARRINGTON.

The annual public winter meeting of the Board was held in the town hall of Great Barrington, beginning on Tuesday, December 5, and continuing through the two following days. There was a large attendance, and the general feeling was that the interest of the meeting had been greater than usual.

The forenoon was devoted to a business meeting of the Board. In the afternoon, at half-past 2 o'clock, Mr. H. A. Barton, Jr., of Dalton, called the meeting to order and invited the Rev. I. S. Hartley, D.D., of Great Barrington, to offer prayer.

Mr. Barton. A welcome will now be extended to the members of the State Board and to the farmers of the State by Hon. J. H. Rowley, delegate from the Housatonic Agricultural Society.

### ADDRESS OF WELCOME.

BY HON. J. H. ROWLEY, EGREMONT.

*Gentlemen of the State Board of Agriculture:* We have met in this place in response to an invitation from the Housatonic Agricultural Society. Associated with the Board and the Housatonic Society, it is my privilege, as well as pleasure, to extend to you a cordial welcome to Southern Berkshire.

Nine years have come and gone since the State Board of Agriculture met in this room. As it was the first meeting ever held in this locality, its object and purpose being imperfectly understood, the meeting was not as well attended by the farmers of the Housatonic Valley as it should have been. The meeting, however, was productive of much good. The seed then sown did not fall upon barren soil. It took root, germinated and grew, the fruit of which was the awakening of a deeper interest among the farmers, causing them to think, study and act, by way of experimenting in growing crops, stock, etc., stimulating the Housatonic Society to greater activity. A new impetus was given to agriculture which gradually worked a departure from the old, rutty, slipshod way of farming, and resulted in a more scientific, systematic and better mode.

The ancient preacher, when he had come before a distant congregation, asked, "For what intent hath ye sent for me?" So the pertinent inquiry might be made by the Board, "Why have you requested this meeting to be held in Great Barrington?"

Here I may be allowed to say a few words in explanation of the object and purpose of what is termed the public winter meeting of the Board. The Massachusetts Legislature annually makes an appropriation of money to be expended by or under the direction of the State Board of Agriculture, for disseminating useful information in agriculture, by means of lectures or otherwise. To that end these meetings are held in the country, among the people, more in touch with the farmers, in the month of December, annually, and are open for all to attend and participate in the discussions which follow the lectures. When sufficient accommodations are afforded, practice and theory are combined, as in the present butter exhibit, and the illustrating the utility of the scale of points in judging animals. They are termed public winter meetings of the Board to distinguish them from the annual business meeting, held in the month of February, at the office of the secretary, in Boston.

Gentlemen of the Housatonic Society, this meeting is your meeting. It is for you. It is for you to avail yourselves of this opportunity of attending and participating in the discussions which follow the lectures, submitting questions, aiding and assisting in making it a success. What it is intended to be is, a meeting of the farmers, for the farmers, and by the farmers. I need not detain you with any lengthy remarks about the Board. It is sufficiently known everywhere. It stands upon its record. Our acquaintance dates back to its organization, a period when book farming, as it was called, and pedigree stock were at a heavy discount with the average farmers of Massachusetts. By persevering efforts the clouds of ignorance have been driven away, the fogs of prejudice pierced, letting in the light of science, and the reports of Massachusetts agriculture, which were ridiculed as the vaporings of cranks and visionary theorists, are sought after, read, studied, accepted and adopted as standard agricultural authorities, at home and abroad. Of the Housatonic Agricultural Society, the visiting delegate of the Board, who has travelled quite extensively, a close observer, free to criticise when he considered necessary, and as free to commend when he saw merit, said at the annual cattle show and fair in 1892, "This society represents more agriculture than any county society in the State." Of the cattle, he said, "I have seen here as good cattle as I have seen in Massachusetts; as good as I saw the other side of the ocean." Accepting his judgment, I need not say more.

I welcome you to Great Barrington, a historic town, possessing many attractions, which need only to be seen to be appreciated — to this beautiful village, hemmed in partly by the adjacent hills, and being what nature designed as the business centre of Southern Berkshire. The national and savings banks, the district and probate and insolvency courts, and the office of the register of deeds are all located here. It has a board of trade, composed of active business men, ever on the alert, looking to the business interests and the prosperity of the village.

Since the former meeting of the Board here, many and great improvements have been made, of which it would occupy too much time to specify all. Several cotton and woollen mills have been built, old ones enlarged, and new ones in process of building, along the Housatonic River. Kellogg Terrace has been erected, at a cost of upward of one million dollars. During the year past, several new business blocks on Main Street have been built, and better, more convenient postal accommodations have been furnished by the United States Government, and the large, commodious Berkshire Inn, furnished with all the modern improvements and fixtures necessary to make a first-class hotel, built, while churches and schools equal to any in the State, a large free town library, healthy atmosphere, good sanitary regulations, excellent roads, magnificent views, beautiful scenery, and pure water, are among the attractions which have contributed to make Great Barrington so popular a resort for summer visitors, vieing with Stockbridge, Lenox and other towns in Berkshire County.

On the westerly side of this village there flows a stream of clear, pure water, made from the numerous springs along the easterly slope of the slaty hills which separate Massachusetts from the State of New York. The waters from these springs run easterly and southeasterly, coming together, and forming what is popularly called the Green River — by the Indians, White River — mentioned in an Indian deed recorded in the registry of deeds in Springfield, describing a piece of land "near where the White River empties into the Husutunnuck." Chemical analysis shows this water to be free from any deadly poisonous substances — perfectly pure. It was on this account that a sample was requested and sent to Chicago for the World's Columbian Exposition. Although much lower than the village, by the use of steam power it is brought into and made to supply the wants of every part of the village, and whoever partakes of it as it is taken from the river has the satisfaction of knowing that he is drinking pure water.

I welcome you in behalf of those engaged in the oldest, noblest and highest calling of man, in behalf of the farmers of Southern Berkshire.

Mr. Barton. It is fitting that a few words in response be tendered by the Board for the cordial welcome we have received. The secretary of our Board, the Hon. William R. Sessions, will now speak to us.

Mr. Sessions. Mr. Chairman and friends from Southern Berkshire: I am happy to respond for the Board. We have come here, not to show ourselves, not to get honor for ourselves, but to discharge, as far as we may be able, the duty we owe the agriculture of Massachusetts. It is the custom of our Board, as the gentleman who has welcomed us has told you, to hold one meeting each winter in some locality for the discussion of agricultural subjects and the spread of agricultural knowledge. Once before, nine years ago, we met with you. Again, in response to the invitation of your people, we have come, as I said before, not to show ourselves or to glorify ourselves, but, as far as in us lies, to benefit the agriculture of Massachusetts, particularly of this valley. We thank you for the welcome. We anticipate an interesting and profitable meeting, one that we hope you will long remember in connection with the one held here in 1884.

You have come to hear agricultural subjects discussed, and it is not fitting that I should take your time by any further remarks. This evening I hope that we shall have a social gathering, with speech, story and compliments. Until then we will give the time to business.

Mr. Barton. It becomes my duty now to turn over this meeting to Judge Rowley, who will be the presiding officer for this afternoon.

The Chairman. Everybody is interested in the growing of food, which sustains life, and consequently they will be interested in the lecture of the afternoon. The title of the lecture is "Raising Crops with Commercial Fertilizers," and I have the pleasure of introducing to you Mr. S. I. Parker of Dalton.

Mr. S. I. Parker. Mr. President and members of the State Board of Agriculture, ladies and gentlemen: I was exceedingly gratified to learn that at the late meeting of the committee of arrangements it was decided that the subject of raising crops with commercial fertilizers should be presented and discussed at this meeting, but was surprised to learn afterwards that the honor of presenting so important a matter fell upon myself.

# RAISING CROPS WITH COMMERCIAL FERTILIZERS.

BY S. I. PARKER, DALTON.

There is no subject or matter that presents such unrelenting obstacles to the financial success of the New England farmer as the matter of fertilizer. He may change the productions of his farm, the keeping of one class of stock to the exclusion of all others, or discard stock altogether; still for three hundred and sixty-five days of the year the subject confronts him. True we have the best markets in the world, and for the most part deal direct with the consumer, thereby avoiding the services of the commission man; but still we cannot escape the terrible burden that rests upon us, adding to the expense account to such an extent that sometimes we are forced to admit in balancing up our accounts of the different crops that the results have not proved a success financially.

The question often arises, How can we procure a material at a low cost, that is lasting, effectual, that will supply the wants of every plant and bring it to perfect maturity, thus leaving us a profit, without this continual warfare against having the balance on the wrong side of the ledger?

We have, in a measure, to compete with the fertile soils of the West; but, as a panacea for some of our wails and complaints, writers and lecturers tell us that those Western soils are fast losing their fertility; still, they continue to feed their fast-increasing population and stock, and send a large amount for consumption here and to ship to foreign countries.

Statistics go to prove that, in spite of all that may be told to the contrary, debarring droughts and wet seasons, with which we all have to contend, they hold their own equally well with the New England States.

As a whole, there is but little commercial fertilizer used by the Western farmer, even in some localities no farther west than the State of Ohio. He considers his stable manure a burden to him. As we all know, he must practice some methods, must have some way to keep up the fertility of his soil. The question naturally arises, what are his methods, what does he consider cheaper to secure and utilize than commercial or stable manures? The answer is, the system of green manuring, with clover the predominating ingredient. Then the question comes to us, why cannot we practice this same method? My answer is, the climate, soil, and perhaps ignorance bring about a condition of things that make it almost wholly impossible for us to depend upon anything but commercial or stable manure; consequently we are compelled by force of circumstances to choose between the two, or use both in combination. This latter, in my opinion, is the most unsatisfactory test that commercial fertilizer has to undergo, both to the farmer and the dealer or manufacturer, for the average farmer expects too much from his stable manure, and considers he receives too little from his expenditure for commercial fertilizer.

The use of stable manure alone gives poor returns for the cost and labor required in producing and placing in position to be utilized, owing to our short seasons, and to the small amount of soluble matter which each year becomes available as plant food, even from a large amount of manure necessary to give life-force and bring to perfect maturity a crop, guaranteeing a satisfactory result financially. Thus we see many a farmer laboring day after day, from early morn till late in the evening, to raise a crop to feed his stock to make manure to raise more crops to feed more stock to make more manure. I will leave it to you to decide what more he gets out of his year's labor. In my opinion, it is not policy or profitable to haul the average manure a distance of two miles, even if it was presented to you, as compared with the present price and quality of commercial fertilizers that are to be obtained in the New England States, except in some local places and for some special crops, as those places devoted to market gardening.

The principal question of the times is, Can a person own-ing tillage land discard all stock, exclude all stable manure, employ all labor used upon it, live upon or remote from it, and raise crops and market the same, insuring a good per cent on the capital invested, solely with the use of commercial manures as a fertilizer?

In the year 1884 I purchased my present farm, situated in the town of Dalton, and about 3½ miles east from the park in Pittsfield, consisting of 150 acres, divided as follows: 40 acres of tillage land, balance pasture and woodland. Capacity of farm, 12 cows and 2 horses. I stocked it with cows; made butter which was delivered to customers in Pittsfield, at from 25 to 30 cents per pound. April 1, 1885, took inventory; balanced up my books; paid my debts; found my bank account consisted of a fair amount of stable manure. I thought this rather unsatisfactory, but took fresh courage and went to work; changed to selling milk. Commenced using commercial fertilizer in small quantities; was a little afraid of it, and thought it was too expensive. I increased my stock some; was very particular about family having much spending money. Saved everything that would make manure; drew absorbents a distance of one mile. Worked a little harder. April 1, 1886, took inventory; found stock and productions of farm increasing slowly. Balanced up my books; found I could not pay my debts from the income from the farm, but imagined I could see where it was all coming back with good interest, as I had a large amount of good stable manure, so I started in with a determination to win. Followed about the same methods as in 1886, still using small quantities of commercial fertilizer, with my stable manure; but could not see much good from it. April 1, 1887, took inventory; found everything slowly though steadily increasing; also my debt. I was rather discouraged, but my friends cheered me up; thought I was fortunate, as I had a large amount of very valuable manure. This year used commercial fertilizer freely; top-dressed grass land with it; mixed a liberal amount of salt with some and sowed upon grass land that was so badly infested with grubs that one could kick up the turf with the foot. The result was a good crop of timothy and clover mixed. Tried it side by side with stable manure on grass land, spread in the fall of 1886; the result was in favor of the commercial fertilizer every time. Things began to brighten. Barn full of hay; other crops good. Wintered 29 head of cattle and 6 horses. At this time I received a call to take charge of a wealthy gentleman's farm; sold off all of my stock; closed out everything before the 1st of May, 1888. This year put everything into grass; spread all manure on hand. Rented house, pasture and 10 acres of tillage land. Cut a good crop of hay, which I sold. This was the commencement of what is generally considered a system of exhaustion. In 1889 purchased 3 tons of fertilizer; we also had 1 ton of cotton-seed meal on hand. We spread these on 22 acres of grass land. Harvested a crop of hay estimated at 2½ tons per acre. In 1890 no fertilizer of any kind was bought or used. The result was the harvesting of a crop estimated at 2 tons per acre. At this time I realized that it would be some time before we would again return to the farm to live, and must adopt some system of managing, also in keeping accounts, as we had been letting things run rather loose and careless. Made some poor sales of hay, etc. In 1891 purchased 5 tons of commercial fertilizer; spread the same with a Shaker sower on 22 acres of grass land. The result was surprising. We sold some in the field, estimating the amount of production at 2½ tons per acre, and sold upon that basis for valuation. The most remarkable result of this test was upon a piece of grass land of about one acre that had formerly been used for an orchard. The trees were dead and gone long ago. No one living could tell me when it had been cultivated or had any manure put upon it. In 1884 harvested 16 tumbles of what we term June grass; in the fall of 1884 top-dressed with stable manure, using a Kemp spreader. In 1885 harvested about one-half ton of daisies and June grass mixed. Fall of 1885, top-dressed as before; harvested in 1886 about one-half ton of hay, with a little improvement in quality. I gave up in despair; concluded I would waste no more manure, but would wait for a favorable time to plough and re-seed. In the spring of 1891 resolved to try commercial fertilizer just once; gave it a liberal dressing. The first time I saw it afterward I saw the largest and finest-looking crop of buttercups I ever beheld.

These speedily gave way to other grasses, and we cut a mixture of clover, timothy and red top, an estimated amount of 2½ tons per acre. Since that time it has produced equally as much as the other land on which we use commercial fertilizer.

The expenses and receipts of 1891 were: —

| | | |
|---|---|---|
| To fertilizer and applying, | $195 00 | |
| To harvesting, | 145 00 | |
| To taxes, | 45 00 | |
| | | $385 00 |
| By grass in field, | $105 00 | |
| By hay sold, | 412 00 | |
| By rent of house and land, | 97 00 | |
| | | 614 00 |
| By balance, | | $229 00 |

In 1892, not being satisfied with letting well enough alone, we determined to try one more experiment, to test the lasting qualities of the fertilizers, so we did not buy or use fertilizer of any kind this year. Harvested an estimated amount of 2 tons per acre. It did not seem to have the body or weight it had in years when we used fertilizer, so we were forced to admit that the experiment was a mistake financially.

| | | |
|---|---|---|
| 1892. Cost of harvesting, | $120 00 | |
| Taxes, | 32 00 | |
| | | $152 00 |
| By grass in field, | $40 00 | |
| By hay sold, | 432 00 | |
| By rent of house and land, | 90 00 | |
| | | 562 00 |
| By balance, | | $410 00 |

In 1893 purchased 5 tons of fertilizer, and spread the same with an Acme fertilizer distributor. The result was most satisfactory; we sold in the field $68 worth of standing grass; harvested 45 tons of good quality hay, an estimation based upon weight of hay already sold from space as compared with weight of hay sold from same space in years past.

Owing to the wet spring, we were delayed in sowing the fertilizer, thus losing some of its benefits this season. The result of the labors of 1893 was as follows: —

| | | |
|---|---|---|
| To fertilizer and applying, | $195 00 | |
| To harvesting, | 131 00 | |
| To Acme sower, | 48 00 | |
| To taxes, | 50 00 | |
| | | $424 00 |
| By hay sold and estimated to be sold, | $675 00 | |
| By grass sold in field, | 68 00 | |
| By rent of house and land, | 90 00 | |
| | | 833 00 |
| By balance, | | $409 00 |

Total for the three years, commencing after a lapse of two years from the time of any application of stable manure or the use of plough or re-seeding: —

| | | |
|---|---|---|
| To total cost of fertilizer, | $390 00 | |
| To harvesting, taxes, etc., | 571 00 | |
| | | $961 00 |
| By receipts for three years, | | 2,009 00 |
| By balance, | | $1,048 00 |

In the position to which I had been called, my opportunities to test the merits of commercial fertilizer were more diversified; it was used in raising all kinds of crops generally grown upon our New England farms. Our main and principal crop was hay. We used it upon land that had not been ploughed for seven years, and it would start and mature a good crop of grass where stable manures, by its side, would fail to act satisfactorily. We re-seeded grass land that had become exhausted for the want of fertilizer, and for the purpose of securing a crop of clear timothy or to get a seeding of permanent meadow grass. In each and every case, with two exceptions, it gave entire satisfaction, so that where we formerly purchased from 300 to 500 cords of stable manure per year, we bought commercial fertilizer, increasing each year until 1893, when 5 car loads, 60 tons, was used for grass alone.

Our experience in raising ensilage corn on 9 acres of ground is well worthy of note. We purchased a liberal dressing of stable manure for it, giving $350 for the same; paid for drawing and spreading, $175; total, $525. Used 300 pounds of fertilizer in the drill; the result was a good crop of ensilage corn. The next spring sowed this piece to oats and seeded to timothy. Harvested 35 bushels of oats per acre. The straw was good. The following year we cut a good crop of daisies, with a little timothy mixed in. We top-dressed a part of this with commercial fertilizer; that is now all right; the balance has been ploughed and re-seeded the past season. Now, what was the matter? Something was wrong. It did not certainly give satisfaction for the cost of labor and material used. Brother farmers, it was merely the result of the combination of manures. We received too little from the stable manures and expected too much from the fertilizer.

Our next trial was with 8 acres of ensilage corn. Paid for stable manure, $275; drawing and spreading, $195; used in drill 700 pounds of fertilizer. The corn was extra good, many stalks measuring 17 feet high. The next spring sowed to oats and seeded to timothy. Harvested 44⅞ bushels of oats per acre. The straw was good. The following year there was cut as large and fine a crop of timothy as we would wish to see or possess.

These two tests demonstrated to me the fact that to produce crops at hand, and to follow, by the use of this combination of manures, one must apply enough commercial fertilizer to start, force and mature the first crop, if we expect to receive satisfactory financial results from the cost of labor and material employed.

Our test on rye with commercial fertilizer was equally as interesting, extending over a period of three years, on ground a part of which was in good condition; the balance was in a very poor state of cultivation. Our records show the following: —

| | | |
|---|---|---|
| To ploughing 31 acres, at $3, | $93 00 | |
| To harrowing, at $1, | 31 00 | |
| To sowing, at 60 cents, | 18 60 | |
| To fertilizer, 6⅕ tons, | 223 20 | |
| To reaping and caring for, | 108 50 | |
| To threshing, labor and coal, | 214 21 | |
| To 45 bushels seed rye, | 31 50 | |
| To reapers, | 15 00 | |
| | | $735 01 |
| By 62 tons straw, at $12, | $744 00 | |
| By 899 bushels rye, at 82 cents, | 737 18 | |
| | | 1,481 18 |
| By balance, | | $746 17 |

The next year shows less expense of ploughing, harvesting and threshing of $65. The credit side shows 62 tons of straw, at $13, $806; 862 bushels of rye, at 60 cents, $517.20; leaving a balance on the right side of $653.19. The next year shows a further decrease in cost of ploughing, harvesting and threshing of $42. Credit: 62 tons of straw, at $13, $806; 842 bushels of rye, at 60 cents, $505.20; leaving a profit of $683.19.

The use of commercial fertilizer has been successfully carried into the culture of almost every plant known to the department of agriculture of the New England States, and to many it has ceased to be an experiment; but has become acknowledged to be the only known factor whereby we may be able to cultivate our soils successfully. The time has gone by when a farmer can afford to keep stock to make manure; it must show an undoubted profit individually to be allowed to occupy a place with us, requiring space, labor and the investment of capital.

In the use of commercial fertilizer there are some requirements of knowledge, and to obtain it we require the untiring assistance of our State Agricultural Experiment Station, which communicates with us through the issue of their monthly bulletins, that should be in the home of every farmer or tiller of the soil, who not only should receive but carefully read and study them, thereby showing an appreciation of the labor, thought and calculations based upon a scientific research by its director, Prof. C. A. Goessmann, whose efforts have not been fully appreciated by the farmers at large. His daily life is expended in his endeavors to educate and build up the farmers of Massachusetts. Let us be in closer communication with him, and accept the knowledge obtained through science as our guide and helper. This some of us have neglected to do, owing to the strong disposition on our part to condemn and ignore the advanced ideas and principles of scientific farming.

I feel that dealers in commercial fertilizer, whether dealing in manufactured, mixed or unmixed goods, have done a great work in endeavoring to bring to the attention of the farmers the benefits to be derived from the use of commercial fertilizer, and for it they should receive the thanks of every cultivator of the soil in New England.

The CHAIRMAN. Have you any questions, gentlemen, to ask the lecturer?

Mr. BARTLETT (of Montague). The lecturer says he used 700 pounds of fertilizer. Is that on an acre or on the whole eight acres?

Mr. PARKER. On an acre.

Dr. J. B. LINDSEY (of the Massachusetts Experiment Station). I would like to ask what you mean by commercial fertilizer; that is, do you speak generally of commercial fertilizers as mixed goods which you bought?

Mr. PARKER. Mixed goods or unmixed goods. I buy the chemicals and mix them myself.

Mr. L. W. WEST (of Hadley). What do you buy, and how do you mix them?

Mr. PARKER. I buy dissolved bone-black, blood, bone and meat, muriate of potash, sulphate of potash, nitrate of soda, sulphate of ammonia and ground bones.

Mr. WEST. In that 700 pounds how many pounds do you use?

Mr. PARKER. I could not give it to you in the 700 pounds exactly. In one ton on that piece of land I used 750 pounds of dissolved bone-black, 750 pounds of blood, bone and meat, 200 pounds of muriate of potash, 200 pounds of sulphate of potash, and 125 pounds of nitrate of soda.

Mr. WEST. Ground bone?

Mr. PARKER. No. Ground bone I found was too slow for the crop; but in re-seeding in the fall I could use ground bone with good success.

Mr. Aaron Low (of Hingham). I have been in the habit of using commercial fertilizers ever since they were first introduced to the public, in seed growing and market gardening. We are able to procure as much stable manure as we need, but for the purpose of testing commercial fertilizers, I have for many years been in the habit of using 10 to 25 tons a year in the production of almost every market-garden crop. I find that we can use commercial fertilizers with more economy than we can stable manure at the price we have to pay for it. Bear in mind that in all places where market gardening is carried on extensively manure sells at a high rate. It will cost upon the land from seven to eight dollars a cord. In case you apply, as we usually do, from eight to twelve cords to an acre, we find the balance on the ledger is against us. Two years ago I purchased a place that has probably not had any stable manure on it for fifty years, and I have been applying commercial fertilizers on ground that has laid in pasture, at the rate of from half a ton to 2,500 pounds to the acre. The past year I applied, for potatoes, on a piece of land that formerly bore but very little grass, at the rate of 1,200 pounds to the acre. It was very light land, what we consider good gardening land. The crop came up well, looked extremely well. I think I never saw potato vines look better. They had that sturdy appearance which betokens a good yield of tubers, but an extremely dry time followed which injured the crop. As it was, we had a very fair crop. On another half acre, which we put to red cabbage, I put 600 pounds of commercial fertilizer. That, I think, was without exception the best piece of red cabbage that I ever saw. It made a good, solid, firm head. On an adjoining half acre, a year ago last fall, we applied a dressing of stable manure and sowed to spinach. Although we covered it, the winter destroyed considerable of it. I re-ploughed, applied 600 pounds commercial fertilizer, planted it, and we had upon that half acre just about 200 bushel boxes of extremely good cantaloupe melons; I think as good a crop as I ever saw. The past year we applied 600 pounds of fertilizer to that half acre and put it to turnip beets for the market. We have not reckoned up how many we had from it, but I think somewhere between 300 and 400 bushels, and I don't think there was a single bushel in the crop that was not fit for the market.

There was one idea in the essay which I must take exception to — that we cannot follow green manuring. On light land which we propose to crop the next season I sow rye any time between August and January; let that rye remain until the close of June, and plough it under when it is from two and one-half to three feet high. I think if you supplement that with from 600 to 1,200 pounds of fertilizer to the acre you will find that that green decomposing material in the soil will be as successful and as satisfactory to you as if you had applied a heavy coat of stable manure. I have followed that method every year for quite a number of years.

It strikes me that the use of commercial fertilizers has been demonstrated in almost every section of the country to be so beneficial that we cannot do without them. Some say, "What do you use? Commercial chemicals or only fertilizers?" I use both, but my experience leads me to believe that the farmer cannot manipulate the elements as well as the manufacturers can with the machinery which they use in the factory. It is well known that we must have a certain amount of phosphoric acid and potash and nitrate of soda for the crop.

There is one other thing necessary with our fertilizers as well as stable manure, and that is, a sufficient amount of moisture to make the elements soluble. You must have some means of creating a moisture to keep the crop growing during a severe drought. The ploughing in of green rye helps to retain the moisture. We raise a great many cabbages, potatoes, squashes, etc., for the Boston and adjoining markets. You all remember that years ago we had to pay as high as nine dollars a cord for stable manure.

We cannot possibly compete successfully with the low prices and cheap transportation of western farm products if we have to pay as much as that for manure, and I have been obliged in the years gone by to use a good deal of fertilizer. I have come to the conclusion that commercial fertilizers in comparative tests with stable manure always come out ahead.

I think it used to be said that we should put on from 200 to 400 pounds of fertilizer to the acre to produce a good crop. My experience is that I can double or treble the amount to advantage. We used to consider that the commercial fertilizers were exhausted the first year. I do not believe it to be so. We have applied it on very light, poor land, in drills and in hills, and you would see its effects on the crops of the following year. My experience leads me to believe that on very dry land commercial fertilizers will be much more successful than will stable manure.

I remember a few years ago that on a farm in Essex County, when I resided there, we had what was almost a drifting sand knoll. We ploughed it, and as we all expected the crop would be earlier on such land I put it to tomatoes. We applied the fertilizer mixed in the hill and set the tomato plants. The vines did not grow very large, but I think without an exception they were the smoothest and handsomest lot of tomatoes that I ever grew. (We grow sometimes three or four thousand bushels a year.) Now, I do not think that stable manure upon that land would have produced hardly any crop whatever.

So my experience has been that upon light land, upon land that we generally call good gardening land, the use of commercial fertilizers is much more economical in the production of a paying crop than stable manure; and it seems to me, out in this part of the country, where lands are different from what they are with us (they are level and light), that you can supplement your farming operations by a larger use of commercial fertilizers than I suppose you have heretofore done.

Secretary SESSIONS. You will notice that the gentleman last up spoke of his dry soil, and the gentleman who gave us the essay is located among the Berkshire Hills. This may account for the seeming difference in their experience.

QUESTION. How deep did you till the gardening soil?

Mr. LOW. We ploughed it seven or eight inches. But there is one point about green manuring, and that is, its quick decomposition has always a good effect. We consider it one of the best methods of fertilizing our soil.

Mr. KIRBY (of Revere). What variety of fertilizer do you use to get your best results?

Mr. Low. Since the question was first brought up by Professor Stockbridge, I think I have used almost every one that has been introduced, and I must say without prejudice or favoritism that with the exception of two brands I have always been satisfied with the application of the goods of every reliable manufacturer.

Mr. Kline (of Egremont). I have had some experience with fertilizer, but not very extensive, and I failed to get good results by sowing it on a sod for the grass crop. I always get good results by working it into the soil. Perhaps the speaker can tell me why I do not get good results from top-dressing for grass. Perhaps I did not sow it at the right time, which was some time in April.

Mr. Parker. I have been in the habit of sowing as soon as possible after grass had grown about three inches high. Perhaps your trouble has been in not applying a sufficient amount of fertilizer, or perhaps your combination of chemicals was not right.

Mr. Kline. I used mixed or prepared fertilizers.

Mr. Parker. I have yet to see a bit of grass land so poor that I could not start a good crop of grass with nitrate of soda alone, although it will not mature it without you keep adding to it through the summer. The trouble with all fertilizers that I have found is that the mixed goods do not contain nitrogen enough for my soil. I cannot speak for my neighbors. I can only speak of two farms upon which I have been located in the last seven or eight years.

Question. Does what you have said about nitrate of soda apply to corn in the same way that it does to grass?

Mr. Parker. It does not. For corn we want more potash.

Mr. Ham (of Burlington). I have had much experience for many years in the use of fertilizers, and I come from a town the chief business of which is the raising of vegetables for the market, and we have to use a large amount of fertilizer. I have paid five to seven dollars a cord for stable manure in Boston and Cambridge, and we could do no better than that twenty years ago; but times have changed all around. We can get all the manure we want now for five months in the year for the hauling of it away, and at a very low price the other seven months. What has brought the price of stable manure down to where it is? It is because we can buy a fertilizer that will raise just as good a crop for a great deal less money. I use three kinds of fertilizer. I raise potatoes, squash and cabbage on the three kinds. For potatoes I use the Bradley fertilizer, which I consider a great deal cheaper, and I can raise a great deal better potato than I can with a liberal dose of stable manure. We used to think we could not raise squash without two shovelfuls of manure in the hill, but that is all folly. We can raise better squash, and are more sure of a crop, with a fertilizer in the hill than we can with stable manure. I used to apply manure for raising cabbage, cauliflower and celery, and I can raise better cabbage with 1,500 pounds of fertilizer to the acre than I can with ten cords of stable manure.

Mr. George Cruickshanks (of Fitchburg). The gentleman on my right makes the statement that he applies fertilizer on grass, and he can see no benefit from it. The essayist, upon inquiry, made answer that he used 700 pounds of fertilizer to an acre. Am I right?

Mr. Parker. Not on grass. Seven hundred pounds to the acre on ensilage corn, but not on grass.

Mr. Cruickshanks. I will quote to you Dr. Fisher, whom a good many of you probably know. In a conversation that I had with him last week he said that he had grass land that has not been ploughed for over twenty years. After experimenting for several years he now applies fertilizer at an expense only of $6.50 per acre, and gets from that field an average of two tons to the acre.*

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* Mr. Cruickshanks, being asked by a member of the audience for the formula used by Dr. Fisher of Fitchburg, to which he had referred in his remarks, replied that he could not give it *verbatim*, but thought the doctor would willingly give it to any one who asked him for it.

Information having come to this office that many requests had been made to Dr. Fisher for his formula since the Great Barrington meeting, he kindly volunteered, through Mr. Cruickshanks, to furnish it, together with his reasons for its use, for incorporation with this discussion. Dr. Fisher's communication is as follows: —

"Twenty and more years ago I was in the habit of buying farrow cows in the fall to consume my surplus hay. I fed them well, made butter through the winter, and turned them off good beef in the spring. I felt that I was getting fully $20 a ton for the hay, and still had the manure left. Fierce competition and the growth of monopolies have so far changed the old conditions that now the only way to dispose of surplus hay is to sell it as such in the market. We have always been

Mr. JAMES. A gentleman at my right said he applied 2,500 pounds of fertilizer to the acre. Will he please state how he applied the fertilizer, whether it was once or several times, and what crops he raised on it, and what result?

Mr. LOW. We did that on a variety of crops, but a case which I call to mind was cabbage. The land was very light, had no density of sod, and probably would not produce 500 pounds of hay in a year. We ploughed that up from the 1st to the 10th of June for cabbage. We harrowed it down, furrowed it, and put the fertilizer in the bottom of the drill and filled it in. That would take about 1,200 pounds to the acre. Where we are going to apply anything further we usually do it after we have finished, and we always get good crops of cabbage from commercial fertilizers. In raising a squash crop we should use perhaps 1,200 pounds

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taught, however, that if this course were pursued, and the resulting manure withheld from the land, the poorhouse would loom up in the distance. It seemed to me, in the light of science at this age of the world, that if the chemical constituents of a ton of hay were to be placed at the disposal of a field of grass under favorable conditions, it would furnish the means of increasing the crop one new ton of hay over and above the natural product. The analyses of hay in the past were not as full and complete as now, but I selected, as well as I was able, an average, and worked to fulfil its requirements by supplying the best forms and cheapest materials to be found in the fertilizer market.

"I estimated that an acre of land favorable to the production of grass would yield permanently, under good care, but without added fertility, about two-thirds of a ton of hay annually. To increase this up to two tons it would be necessary to supply the constituents of one and one-third tons. Inasmuch as the time in which the growth and development of the crop is quite short (within six weeks), it is essential that all these forms of plant-food be in a soluble condition, that the plants may be able to appropriate them as fast as needed in the progress toward maturity. What I aimed to furnish was, 33 pounds of potash, 23 pounds of nitrogen, 10 pounds of phosphoric acid, and 4 pounds of magnesia, the soil having the capacity to supply the smaller quantities of other substances required. The varying cost of materials in market has indicated those to be chosen from time to time, but at present I am using: —

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|---|---|
| To furnish the potash, . . . | 65 pounds muriate of potash; |
| For the nitrogen, . . . . | 60 pounds sulphate of ammonia and<br>75 pounds nitrate of soda; |
| For the phosphoric acid, . . . | 40 pounds South Carolina floats; |
| For the magnesia, . . . . | 25 pounds sulphate of magnesia; |
| To which is added, . . . . | 75 pounds plaster. |
| This makes a total of, . . . | 340 pounds, |

which cost at the railroad station here last spring, delivered in ton lots, $6.28.

"This formula is applied broadcast as early as possible in the spring after frost is out and the ground settled.

"It will be noticed that the phosphoric acid in this formula is insoluble, and therefore does not conform to the conditions given. There are two ways of remedying broadcast, and then put in a couple of handfuls to the hill. They would mature quicker and have a more vigorous growth than they would on manure. But with potatoes, for instance, we should apply from 2,000 to 2,500 pounds to the acre, and apply it about the 1st of May around the potatoes; but you must bear in mind that unless there is moisture, to make the fertilizer soluble and effective, it will not have as good results. It is much better to have its application followed immediately by rain. For instance, we have perhaps half an acre of rhubarb, and last spring, just as the plants were starting above ground, we applied a dressing of nitrate of soda and potash. From that half acre we sold the past year four tons. The market dropped down so low that we ceased to market it. I think we could have sold half as much more. Now, that fertilizer is for the production of leaf and stalk. But there are some crops where you desire to produce a head or an ear of corn rather than a stalk; then you need phosphoric acid with the nitrogen and potash. When we apply 2,500 pounds of fertilizer for potatoes we always expect to follow

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this. One is, to use the soluble acid as found in dissolved South Carolina phosphate, or dissolved bone-black, at an increased cost each year of some 45 cents; or another, which I prefer, is, to apply the first year, say, 160 pounds of floats in place of 40, and afterwards the amount given in the formula. This will add to the cost the first year $1.33, but will furnish a sufficient and continuous amount of phosphoric acid as required. My preference is given to floats because it is the cheapest source of phosphoric acid, and its fineness makes it approach in value in my experience the reverted acid, which is priced by the chemists the same as the soluble.

"I am not aware that a prepared fertilizer having the relative composition indicated by analysis of hay is offered for sale, and I feel obliged, therefore, to purchase the ingredients and mix them myself. Compounds for this purpose have an unnecessary and what seems to me an unwarrantable excess of phosphoric acid as compared with the potash and nitrogen, which latter are thus deficient. I have used essentially this formula annually for many seasons, and some of my grass land has not been ploughed for more than twenty years, while the yield has been, as near as could be estimated, two tons of hay to the acre as a first crop.

"If the hay is intended for home consumption and it is desired to largely encourage the growth of clover, I would substitute for the muriate of potash the same weight of high-grade sulphate, at a cost of 25 cents extra, or six or eight bushels of ashes of good quality. The extra cost in this case could perhaps be more than saved by reducing the amount of one of the nitrogen-furnishing ingredients, the clover plant acting as an efficient substitute.

"It is very important in commencing the use of any fertilizer to have the sward made up of those grasses the growth of which it is intended to encourage. All the fertility imaginable, in the absence of plant or seed, could not originate plant-life. If the grasses wanted are not present, re-seeding is essential. If they are to be found, but unthrifty from a deprivation of fertility, then the way open is clear."

that by a crop of cabbages or spinach later, and get two crops in one year from the application.

Mr. Ware (of Marblehead). It seems to me the line of this discussion is a little misleading in one particular. For instance, our friend, Mr. Parker, says he applies 700 pounds. Another friend says he applies 1,200 pounds of commercial fertilizer, Bradley's or Stockbridge's or some other. Do both these gentlemen apply plant food, nitrogen, potash and phosphoric acid in the same proportions or is there a marked difference between chemicals mixed by the farmer and the mixed or complete fertilizer sold in the market?

Dr. Lindsey. Of course, there are commercial fertilizers and commercial fertilizers. If you will take the ordinary so-called phosphate which is sold, it matters not by whom it is made, and which retails possibly for about $35 a ton, that phosphate or superphosphate, whatever you may call it, has somewhere about 2½ per cent of nitrogen, about 9 per cent of available phosphoric acid and about 2½ per cent of potash. I think that any fertilizer agent in the hall will bear me out in that statement. Now, 2,000 pounds of the fertilizer mentioned by Mr. Parker would have, perhaps, in round numbers, twice as much plant food as would the ordinary phosphate above referred to. On the other hand, some of the so-called *complete manures* sold by various companies would contain approximately as much plant food per ton as is contained in 2,000 pounds of the fertilizer mentioned by the essayist. When, however, I speak of complete manures I mean those that will analyze 4½ to 5 per cent of nitrogen, and possibly 6 per cent or 7 per cent of available phosphoric acid, and about 6 to 8 per cent of potash. Whether or not the plant food contained in the complete manure would be found to be in as available forms as that contained in Mr. Parker's fertilizer would be another question.

I have a few words more to say, if I have the time. In the first place, this discussion in regard to commercial fertilizers seems to place stable manure entirely in the background. I think we are going to the other extreme. Shall we not for a moment inquire what stable manure really is? It is, first, the *undigested part* of the food consumed by the animal — *i. e.* the feces; second, the water excreted by the kidneys, containing in solution the end products of the decomposition of the nitrogenous part of the food that has already been assimilated by the animal — the urea and hippuric acid — together with nearly all the alkalies and small quantities of phosphoric acid and lime. This second excretion we call the urine. In addition to the feces and urine, stable manure contains, as we all know, straw, sawdust or whatever coarse materials are used as absorbents. To recapitulate: The feces, or solid part of the manure, is that part of the food fed that the animal cannot digest and assimilate, and contains one-half of the total nitrogen and three-quarters of the phosphoric acid, lime and magnesia excreted. The liquid portion, or urine, contains the other half of the nitrogen and nearly all the potash and soda, and about one-quarter of the phosphoric acid excreted.

One ton of average stable manure that is so protected as to contain nearly all of the urine has the following percentage composition: —

| | Per cent. |
|---|---|
| Water, | 70.00 |
| Nitrogen, | .50 |
| Potassium oxide, | .50 |
| Phosphoric acid, | .30 |

Now, upon the quality of the food fed depends the quality of the manure produced. If we feed rich nitrogenous foods that contain also considerable quantities of phosphoric acid and potash, such as cotton-seed meal and linseed meal, we shall produce a manure correspondingly rich in these ingredients. Remember that of the total nitrogen, phosphoric acid and potash consumed in the food, 80 to 90 per cent of it is again recovered in the manure. With such a large amount of these several ingredients thus recovered it must be clear that it would be more economical to turn our hay, corn and other articles of a similar nature into milk and butter and thus retain upon the farm the large quantities of the fertilizing ingredients they have taken from the soil, rather than to dispose of them direct. In other words, I mean that the mixed system of farming must still continue to be the system pursued by the larger part of our Massachusetts farmers. They must depend upon barnyard manure as their chief source of supply, supplementing this when necessary with commercial fertilizers.

We now come to another question that has been discussed here this afternoon, namely: Can crops be grown upon commercial fertilizers alone? Ten years ago farmers generally looked upon the so-called commercial fertilizers as stimulants and not as actual plant food. This idea is being slowly but generally discarded. Plants in order to develop themselves must take potash, soda, lime, magnesia, iron, sulphuric acid, phosphoric acid and nitrogen from the soil. Nitrogen, phosphoric acid and potash are especially lacking, and it has been found necessary to supply them from some source or other. Now, it matters not, other things being equal, whether you supply these ingredients in the form of barnyard manures, or in the form of commercial fertilizers. Give the plant opportunity to get them in an available form and crops can be brought to maturity, because these ingredients are nothing more or less than the real plant food. I have time only to call your attention to the beneficial mechanical effects of barnyard manure, and cannot stop to consider the special forms of plant food most valuable to certain crops or classes of crops. Neither have we time to consider how stable manure can best be utilized upon the farm, and why it is better suited to some crops rather than to others. I believe, however, that fully as good crops can be raised upon the farm by applying the so-called commercial manurial substances, providing they contain in approximately correct proportions sufficient quantities of phosphoric acid, nitrogen and potash, as by the liberal applications of barnyard manure.

I think the questions of economy and environment will have to be seriously considered before we can fully settle in our minds as to whether or not we shall use barnyard manures or commercial manures in growing our crops. You will notice that I said that a ton of average stable manure contained 70 per cent of water. In every ton of manure, therefore, carted on to our fields, we are carting 1,400 pounds of water, 10 pounds of nitrogen, 10 pounds of potash and 6 pounds of phosphoric acid. Now, we must all agree that labor is a very important consideration in a successful farm management, and I do not believe that we can afford to haul manure long distances. The cost of handling this bulky material must be carefully considered by the farmer.

Again, certain farmers may be so situated that it would be far more economical for them to depend perhaps almost exclusively upon commercial fertilizers in growing their crops. Local circumstances and conditions will determine which course it is wiser to adopt. In summing up I would say that I am perfectly confident that crops can be grown successfully on commercial fertilizers, providing they get the requisite amount of food in the form of nitrogen, phosphoric acid and potash to enable them to reach their full development. I further believe, however, that it is for the best interests of by far the larger number of our Massachusetts farmers to pursue a mixed system of farming, turning their fodder articles into butter and milk, and returning the elements of fertility that these crops have taken from the soil back again, and supplementing their manure produced upon the farm by a rational use of potash, phosphoric acid and nitrogen purchased in the form of commercial manurial substances.

Mr. CHAMBERLAYNE (of Bourne). Mr. Chairman, there is but one subject in connection with the use of artificial fertilizers of which I know anything whatever, but to that I have given the thought and consideration of a large number of years. I have prepared a statement for submission to this meeting upon that aspect of the fertilizer question, and I shall ask permission to state in brief the point which I am endeavoring to place before you, desiring that the statement which I have prepared may be taken as my remarks. The only point — and I shall take but a moment of your time — is in relation to the very important one of fish as a source of fertilizing material in plant food. I am afraid that all the members who are before me do not recognize how absolutely important that question is to our section of the State. It is a question which we have to consider every year and all days in the year; and it is a question on which it is important that legislation should be had. It is the farmers who are going to decide what that legislation shall be, and one side of that question has been very fully submitted to this Board at its last annual meeting. Therefore, I desire, as representing the people upon Buzzard's Bay, to submit the other side of the question in the form of the remarks which I shall leave with the proper officer. I do not feel that it would be desirable at this late hour, even if your patience extended so far, to weary you with the citations and authorities which are necessary to sustain our idea of what the interests of the farmers require with regard to this matter of fish. There is, however, I may say, an effort which has been made to place it before the farmers of the Commonwealth as a matter where the interests of the farmers are conflicting with the interests of sportsmen or dudes or *dilettanti*, individuals who come down to our section for the purpose of residing upon our shores.

Now, that is not the case. For thirty years, ever since 1856, the waters in Buzzard's Bay have received legislative protection from the Commonwealth. They have received it not for the purpose of enabling people to catch fish there for sport, because that was prior to the time when any sport could be had in those waters, and when we had no summer population whatever; but those waters were protected for the purpose of maintaining a spawning ground, a breeding ground and nursery for young fish. That is the reservoir from which the food supply of the adjacent waters and our waters are recruited, and to-day it is an absolute necessity of business that that protection should be maintained.

Mr. ———. Mr. Chairman, I would like to make a point of order — that these remarks are hardly pertinent to the subject before us.

Mr. CHAMBERLAYNE. I will then limit my remarks.

The CHAIRMAN. It is getting rather late, so I hope the gentleman will be brief.

Mr. CHAMBERLAYNE. Then I will simply say that I would like the privilege of submitting my remarks to the secretary, and having them taken as what I wish to say.

Secretary SESSIONS. Certainly, they will be accepted, and if pertinent to the question and of interest to the farmers of the State, they will be used.

Mr. CHAMBERLAYNE. I think that will meet the views of the gentlemen who raised the point of order.

Mr. FENN (of Milford, Conn.). I would like to ask the essayist this question: Why do you use sulphate of ammonia in connection with nitrate of soda, when your nitrogen costs you more a pound in that way than it would if you used nitrate of soda alone? And also, why do you use sulphate and muriate of potash, when potash in the form of sulphate costs more? I may say while I am up that I have been mixing my own fertilizers for quite a number of years. Those of you who get hold of the Connecticut report will find my name there among those who make their own mixture. I commenced, like the speaker, to use various ingredients. I used nitrate of soda in connection with organic nitrogen and blood, bone and meat. I am led by my own experience to ask him the question. I am after information. I bought mixed fertilizers until I became convinced that they cost too much money for the amount of plant food that was in them. Since then I have bought the chemicals and mixed them myself, and have carried on experiments on my place to learn what my soil needs. It was formerly supposed, especially by a good many manufacturers, that to obtain a good crop of potatoes you must have 10 per cent of potash in your mixture. I used to think so, but my experiments have led me to reduce that amount to about 4 per cent. I have a neighbor who for three years carried out a series of experiments under the direction of the Experiment Station, and the consequence is that he only uses 2 per cent of potash, and he grows a splendid crop. I think, therefore, there is an advantage in buying the chemicals rather than mixed goods, as by so doing we can apply the proportion of the different elements of plant food that our own soil requires.

I want to take a little exception to what Mr. Low says. He believes that the fertilizer manufacturers can mix them better and cheaper than the farmer. But I kept an account, and it cost me to mix it 80 cents a ton, and I believe the farmer can do it equally as well as they can.

Mr. Low. Do you consider the average farmer is competent to mix his own chemicals? Does he know the proportion, etc.?

Mr. Fenn. In reply to the gentleman I will say that I think any ordinary farmer can do it. It is a matter of measuring his ingredients. That is all there is to it. I thought it was hard work at first, but I find it is not so. I believe that a majority of the New England farmers are able to figure that matter out.

Mr. H. C. WEST (of Hadley). I should like to ask the essayist one question. He spoke of using six car-loads of fertilizer. I would like to know what chemicals he bought. What I want to get is the number of pounds of each kind that he bought for the six car-loads.

Mr. PARKER. There were five car-loads. There were five cars and 60 tons, 12 tons on a car. Each ton contained 900 pounds of dissolved bone-black, 600 pounds of blood, bone and meat, 200 pounds of muriate of potash, 200 pounds of nitrate of soda, and 100 pounds of sulphate of ammonia.

Dr. LINDSEY. May I ask you what that bone, blood and meat analyzed in nitrogen ; do you know?

Mr. PARKER. Six to eight of ammonia and ten to twelve of phosphoric acid.

Mr. NYE (of Barnstable). I agree with the gentleman on my left, that we ought to utilize all our barnyard dressing ; but there are some crops which do better on fertilizers than on stable manure. I raise all my potatoes on commercial fertilizers, but there are other crops on which I use barnyard dressing. Last year I took a piece of pasture land which had never been ploughed in the memory of man. I put on twenty horse-loads of barnyard manure and planted corn, and I raised 75 bushels of corn to the acre. This year I ploughed the same piece and put on one ton of fertilizer to the acre, and raised 425 bushels of potatoes on an acre and two-thirds. That is on Cape Cod soil. So I think that for potatoes I should use commercial fertilizers — buy them of the manufacturer or mix them myself. I am not satisfied which is the best, but for my corn I should use barnyard manure.

Secretary SESSIONS. Will the essayist give us the amount per acre which he applies for top-dressing of grass land?

Mr. PARKER. I have put on 455 pounds on my farm per acre, and from 400 to 500 on the gentleman's farm that I had charge of. But on the piece of land on which I made the experiment, that I spoke of in my paper, no one has any recollection when any manure or fertilizer was used. I put it on that at the rate of 1,200 pounds to the acre. And, as you will see in my paper, I have omitted two years when I did not use any fertilizer; but I am satisfied that with 450 pounds to the acre for several years in succession I get a crop of three tons to the acre. I think that would be a safe estimate.

Secretary SESSIONS. What did it cost you to mix and apply it?

Mr. PARKER. To mix and re-pack $1 per ton, and to apply it cost in the neighborhood of $1.50 or $1.25. I have done it for $1.25 a ton. I use the Acme fertilizer distributor.

Secretary SESSIONS. How much help do you need?

Mr. PARKER. One team and two men.

QUESTION. How much will be the expense to the acre for the fertilizer and applying it?

Mr. PARKER. Well, I have not figured that, so I cannot give it.

Secretary SESSIONS. How much is the cost of a ton?

Mr. PARKER. Thirty-six dollars, and one dollar for mixing, and we have mixed and put on five tons in one day with two men and a team. That would make about $38 or $38.50 a ton applied.

Mr. CHAMBERLAYNE. Have you at any time made any computation as to the relative cost of the plant food as you mix it yourself with the same value of plant food in the ordinary superphosphate?

Mr. PARKER. I have not. I could not tell that.

Mr. CLARK (of Granby). I would like to inquire, in relation to that crop of rye, as to what would probably have been the production of that land without the fertilizer, and also whether you applied the fertilizer at the time you sowed the rye or in the following spring?

Mr. PARKER. I think the first year that the rye was sown we might have received two-thirds as much without fertilizer; but in the next two years I hardly think one-half the crop would have been realized. We applied the fertilizer at the time of sowing the rye.

The CHAIRMAN. I am sorry to break off this discussion, but in order to carry out the arrangements of the Board we shall have to consider this meeting adjourned until to-morrow morning at half-past nine.

The officers of the Housatonic Agricultural Society tendered a banquet and reception to the Board of Agriculture at the Berkshire Inn, Tuesday evening. The bringing together in this manner the Board of Agriculture, invited guests and citizens of the neighborhood was in every respect delightful and was thoroughly appreciated. A male quartette from Pittsfield added much to the enjoyment of the evening.

## SECOND DAY.

The meeting was called to order at 10 o'clock by the Chairman, Hon. J. H. Rowley, who said: Gentlemen, the time has arrived for the opening of this meeting. The lecture this morning will be from a gentleman whom many or all of you have seen and all will be pleased to hear from, on the subject of "The Handling and Feeding of Dairy Cattle," by Ex-Gov. W. D. Hoard of Wisconsin.

Ex-Gov. W. D. Hoard. Mr. President, ladies and gentlemen, and members of the Massachusetts Board of Agriculture, friends and brethren: I owe you an apology that is difficult to make — that is, one in advance. I prefer always to apologize after the offence rather than before it, for then I am more sure of my ground. Mark Twain said that he always preferred to introduce himself to an audience, because then he could get in all the facts, and I am somewhat in that condition in regard to this proposition.

My paper to-day is in many particulars too long, and I shall have to ask your good and kind indulgence. I tackled a big question, and the more I contemplated it and drew upon the conclusions of my lifetime, the more important some things seemed. And still I shall not be able to deal technically with the question, but strive to reach down and, if possible, get hold of principles.

# THE HANDLING AND FEEDING OF DAIRY CATTLE.

BY EX-GOV. W. D. HOARD OF FORT ATKINSON, WIS.

In all the events of life there seems to exist a certain law of sequence. There is a first step and it must be taken first or we are at cross purposes with our central purpose all through.

By this same law of true sequence spoken of I place handling a cow before feeding her, for the ruling reason that environment and its influences come first. Environment will always and easily alter the effect of feed, while it is difficult for feed to change the effect of environment. For the sake of a more simple term I shall use "handling" in place of environment. I will define handling under the following heads: —

(1) Pasture range and its character.
(2) Winter shelter, barns, stables, etc.
(3) Methods of fastening.
(4) Sanitary conditions, ventilation, watering, exercise, etc.
(5) Humane treatment.

I cannot treat of either of these subdivisions minutely because of lack of time. All I can do is to speak of the ruling principles which govern for good or ill in each.

I will premise by saying that a great many farmers seem to forget, in handling their cows, that they are dealing with the problems of life and maternity.

I desire a moment's prayerful reflection on that question, and I do not utter the word "prayerful" irreverently, for if there is a subject that calls for profound reverence, it is the question of maternity, and no man has a right who respects his mother to forget its existence, even down to the lowest forms of life that God has made.

They forget that they are in contact with the most sensitive physiological machinery in existence — that of motherhood. They think and act toward their cows as if they were so many cast-iron machines. Such ideas lie at the bottom of a large portion of so-called ill luck in the business. Physiological results can only be had by the use of physiological understanding. Milk is the physiological result. The mystery of these maternal functions is just as great in the bovine mother as in the human mother. We have profound students and great institutions of medical learning to evolve the truth concerning the human mother, and still she is very much an unsolved mystery. We have ignorance, blind selfishness, and cruelty in many instances, and a lack of good thinking quite generally to evolve the truth concerning this bovine mother; and, as if to add the cap-stone to our folly, we wonder why her motherhood is not more profitable to us. Let us remember one thing, and remember it devoutly: God ruleth over all. His laws govern. If we persist in ignoring or violating the laws that relate to the motherhood of the cow, then we are sure to meet with a loss of success as a punishment. Hence the necessity of being as gods, *knowing* good practice from evil practice, and *why* one is good and the other evil.

I start with the supposition that every man desires only good cows and that their goodness be maintained to his largest profit.

## Pasture.

A good pasture, one that is conducive to the most profitable results, is one that yields an abundance of sweet, nutritious grass, with the least exertion possible on the part of the cow. A poor pasture is one either short in food or that yields poor food, or that requires too large an expenditure of exercise to crop a day's ration. If either of these poor conditions exists it may be taken as an evidence of bad management, poor handling. Hiram Smith, the noted Wisconsin dairyman, who successfully kept one hundred cows on two hundred acres of land, always claimed that his pasture food cost him more per dried pound than winter food. A study of all surrounding economies reveals usually a higher range of cost of product to price received than in winter.

The waste of succulent herbage by treading down is enormous. As yet no one has suggested a practical remedy for this evil. As the pasture grows short the cows increase their exercise to obtain food, causing shrinkage of milk, and hereby a double loss soon ensues. There is an intimate relation between bodily ease and full-fed contentment and the largest production of milk. A profitable cow with plenty of food never seeks exercise. The expenditure of nervous and physical force sufficient to produce a full flow of milk is very taxing to her. The practice of dividing the pasture into several divisions and allowing the grass in one to recuperate and freshen in growth and flavor before turning in again is very important, and is practiced and highly commended by a few who have tried it.

### To and from the Pasture.

Serious losses occur quite frequently through hasty and inconsiderate driving, particularly from the pasture at night. I could quote numerous instances that I have investigated of severe loss in average milk returns of the herd through use of a dog or stupid boy. And a boy is usually as he is born and trained. Very much to the discouragement of my father in the early part of my life, this did not seem true. If the old gentleman were living now — peace be to his memory! — I believe that we should both of us come nearer together than we ever did before.

These facts are being brought out quite rapidly now that the daily fat content is taken in creamery work. Every owner should provide himself with means of detecting these losses before it is too late to correct them. That means buy a Babcock tester. Any man who has five cows and cannot afford the sum of $2 per cow for a period of years for a Babcock tester that will cost him $10 and will last ten years — if he cannot afford this means of determining that which he could not otherwise determine, he is standing in his own light. A small feed of bran to each cow at the milking stable will soon bring the whole herd regularly to the yard and promptly so at night.

An old German in my county said once: "Der dog vill do pretty vell for der bull. Dat don't hinder der bull very much; but a dog for a cow ish a humbug on der man dat own der cow."

### Shelter in Summer.

Cows need shelter in summer much oftener than we are apt to think. I doubt if it is wise to allow them to remain in a rain storm even in midsummer. In our eight creameries we have kept close watch of the effect of such conditions on milk yield, and we have found that a long rain storm, even in hot weather, is almost certain to reduce the fat percentage of the milk. The Babcock test is telling some very important truths nowadays.

The fly pest is becoming a most serious question. For the past three years a large number of dairymen have followed the plan of keeping the cows in the stable, well darkened in the daytime, and turn them loose to graze at night. The Horn Fly, however, seems to operate with about the same ease in the dark as in the light, and no relief is experienced short of the application of grease compounds. Where the Horn Fly has most abounded it is thought they will cease their depredations after about three years. Of course, where the cows are kept in the stable in daytime they must be partially soiled. Nothing is better for this purpose than a growth of oats and peas, sown on very early ground at the rate of two bushels of oats to one of peas. The White Schœnen variety of oats, on account of its stiffness of straw, and the small Canada pea, make an excellent combination. But the cheapest and best system of summer soiling is through a silo. Summer stabling requires extra care to keep down all foul odors, and I would especially recommend a liberal sprinkling of land plaster every day in the morning and at night. This will instantly absorb all ammoniacal gases, and also prevent the floors from becoming slippery. Cows handled in this way amid heat and flies last summer, with their food supply kept up, to my personal knowledge, showed scarcely any falling off in milk flow.

## Shelter in Winter.

Of course, the northern farmer understands the necessity of good barns, but even in the milk-producing districts tributary to New York, there is a strange lack of understanding when and how to use them. I have ridden on the cars through various old dairy counties in New York and have been really amazed at the wastefulness of dairy farmers.

Gentlemen, let me add a word. The cost of waste in the United States to-day is greater than the cost of production. I believe it absolutely and emphatically — the cost of waste is greater than the cost of production. It is difficult to get men to see often where they waste. With the mercury down to 5 below zero I have seen a whole neighborhood of cows turned out of the barn at 9 o'clock and left to wander around the fields, ankle deep in snow, till 4 o'clock in the afternoon. In many instances, the farmer would even go further in reckless expenditure and haul out a load of good hay and feed the cows on the snow as a noon bite. This was done under the mistaken idea that the cows must have that sort of exercise in order to keep healthy. No cow can long give milk profitably under such treatment. The secretion of milk presupposes at the outset a relaxed condition of the system. To promote this, a milk-giving degree of warmth is necessary. Warmth relaxes and promotes the secretions; cold contracts them. Cold increases the consumption of food without corresponding increase of product. These cows were badly handled and their owners were not using dairy intelligence, while at the same time they were subjecting themselves to dairy expense.

## Barns and Stables.

In the construction of the modern dairy barn, there are certain considerations that belong to the day and age we live in. First, they must be well ventilated. Second, they must not be overcrowded. Third, they must be well lighted. The matter of cheap and effective ventilation is a difficult one to deal with. We must warm the stable with the heat of the animals' bodies. If we draw off the warmed air to supply fresh air we lower the temperature. There is only one way out of the difficulty that I can see, and that is to allow at least from 800 to 1,000 cubic feet of air to each animal, and more, if possible. To do this we must either stable a less number in a room or build the stable room wider or higher. I believe lumber is cheaper than tuberculous cows, and I am very certain that a great improvement in the healthfulness of the stable would ensue by making it two feet higher than they are usually built. Square wooden ventilating pipes can easily be built from the stable to the roof, starting at about two feet from the floor. They do not work perfectly always, as sometimes the current sets downward. It is well to insert a sliding damper to regulate the current.

It is a serious question with many whether it is not a bad practice to store hay and fodder over the cows. The finest barn I ever saw, as shown by the appearance of the cows, was in the form of an L. The hay and ensilage was at the end of the short angle. The cows were tethered heads towards a centre feeding alley in the longest angle. The centre alley was ten feet wide, ran through both angles, and seven feet overhead was hung an iron railway. Suspended thereto was a large box on rollers capable of holding 1,000 pounds of ensilage or about 300 pounds of hay. This was filled with either hay or ensilage as desired, at the fodder end of the building, and rolled along on the overhead track in front of the cows. One man can easily push the box along on the overhanging railway loaded with all it can hold. In this way the fodder was kept free from all effluvia from the stables, and thorough ventilation was easily secured. This barn was built for the Gordon Guernsey herd near my home, and I studied its effects with great interest. It was only a story and a half stable, quite cheaply built, but I certainly never saw cows thrive better than in this barn. Every cow barn should contain one or more box stalls for a sick cow or one about to calve. That dread disease, milk fever, may often be averted if the cow is placed in the box stall a few days before calving, where she can have full, free use of her body during parturition. Again comes the solemn injunction to study well this question of motherhood. The box stalls should command full view of the other cows, to promote contentment in the occupant. They should also be thoroughly and often cleaned and well disinfected after each birth therein. Parturient apoplexy sometimes occurs from contagion derived from a lack of disinfection and cleanliness.

### LIGHTING.

Go where you will in the old dairy districts you will find nine out of ten of the cow barns built on the underground plan. They are dark, damp and poorly lighted. This is an unsanitary condition, causing tuberculosis, abortion and other diseases which plague the dairyman. Lack of sufficient windows makes them dark; the large amount of moisture voided in the urine and exhaled in the breath makes them damp. Put in plenty of double windows. The effect will soon be noticed in the increased tone, vigor and brightness of the cows — my word for it, if you choose to take it, for I have seen it occur dozens of times — and in an increase of color in the milk. In summer when the cows have plenty of sunlight the butter is yellow. In winter it is white. The green, succulent grass has much to do with the question of color in butter, but sunlight has more to do with it than many suppose. Men and vegetables grow white when confined in a dark room. The London butchers wish for white veal and to secure it they contract that the calf shall be fattened in a dark room. The effect on the cow and the color of her butter is the same. In the consideration of all these questions, affecting as they do present profit and future stability, we should remember that old methods have come up from men who first consulted their own convenience. The first thought was to save labor and expense, whether it was best for the cow and her final profit or not.

Our first consideration should be to do that which will promote the efficiency of the cow. To do this we must promote her comfort. We must invest time, labor and capital to promote it, for we *sell the results of that comfort.*

Did you ever think, my friends, that we are selling comfort when we are selling milk?

We are not selling our own comfort or prejudices to the consumer. Hence the higher economy of modern dairy purpose. It is in the light of the highest not the lowest economy that we must study and act. I learned a valuable lesson on this principle from an old German years ago. I had started a little local paper, the foundation of the present "Hoard's Dairyman." I was very poor in pocket and poorer yet in judgment and courage. My old German friend came in to see me.

"Well," he says, "that newspaper is a little thing, hey?"

"Yes," I answered, "quite little."

"Don't you mind that," was his comforting response. "Every man's business is just like a carrot that grows in the ground. Way down in the dark is the little end; up where the sun shines is the big end. If a man measure his business in his mind by the little end, then always he stays right there. But if he measures his business by the big end, then in a little while he come up where the big end is, and he own der liddle end too."

### Fastening Devices.

In selecting a method of fastening cows in the stable, I believe it to be of the highest profit to *first* consider the physical economy of the cow, and the promotion of her milking function. That is "der big end of the carrot." Too many first consider the economy of room, "how many can I crowd into a given space," or economy of time and labor. It is my business to exchange labor for money and I am all the time looking for a chance to invest time, labor and capital, not to save it, but to invest it.

I must invest it at the highest economy; but my wife taught me a lesson once about economy when I was preaching to her the necessity of denying ourselves. She said, "That is not economy; that is privation. Economy calls for a wise spending of means," and I said, "Madam, I bow to your interpretation of this question. I guess you are right." She has been very often right, much to my chagrin.

I know of no place in the economy of dairying where time, labor and capital can be invested with better profit than at the cow end of the question.

I am solidly convinced that the rigid stanchion should be indicted for being a barbarous and unprofitable device. It was invented solely for the comfort and convenience of the owner, and not for the cow. The bruised, swollen knees, the cramped, rigid position in lying, the very frequent instances of injured teats and udders by being trod on by companion cows, the very evident lack of that ease or comfort so necessary to a mother if she gives you her best effort in the production of milk — all these are sufficient to make the indictment hold. All of these things constitute the force and effect of handling.

### Watering.

How many men here before me have determined for themselves how much an ordinary cow of 1,000 pounds will drink on winter feed? It would seem as if we should know about this in order to have a good judgment in the premises. I find that the range is from 80 to 150 pounds a day, with, say, seven of the latter to three of the former. Cows giving a large flow of medium quality milk will drink the most water, as a rule. I have spoken of the effect of cold on the secretion of milk. The same law applies to the use of cold water in winter.

If any of these men here will consult his mother, or wife, if she is a mother, they will quickly inform him of the fact that when they wish to promote the flow of milk for a nursing child they use only warm drinks. The law that governs lactation is the same with the bovine race as with the human. Once let a dairyman get this principle firmly implanted in his mind and he will find it invaluable as a measuring guide as to what he should do. Take that alone. Do not ask for technical definitions but take it in its entirety, and go on with it and let it tutor every touch of the hand, and it will do marvels. The mischief is that we have put the hand to this wonderful machine called the cow, before we sanctified it with the brain, and we have made many sad mistakes. The saving we will find, is not so much in labor as in the feed, or rather in making the feed more effective to our purpose. Here again do we see the influence of environment or handling on feed.

### Exercise.

On this question I believe the following proposition to be true: As little exercise as is possible, consistent with health and vigor. We handle and feed for milk. Exercise costs feed and a lessened production of milk. We cannot evade the working of that law. But a certain amount of exercise is no doubt necessary for health. Let us always remember, however, that if we shut the cow up in a barn for six months for the sake of extra flow of milk, no doubt we will get it; but we must take extra pains to make the environment as perfect as possible. She must have good air, plenty of light and dry quarters. We must never forget that the giving of milk is a function of motherhood, and we must be obedient to all laws that promote that function. The natural instinct of a cow, when left to herself, is to eat her fill, if she can get it easily, and then lie down and digest it. The law that governs the health and development of the male does not apply to the female in this particular of exercise.

## Feeding.

At the outset let us consider what the dairy cow produces. Milk is a highly nitrogenous compound. The caseine is almost a pure albuminoid and is one of the three chief constituents of milk. It is almost amusing to note how crude are the judgments of some dairymen on this subject. Last summer a neighbor asked me for a reason why certain foods were recommended for butter cows. I commenced by trying to show him the character of milk, how it was composed of about 4 per cent butter fat, 3½ per cent caseine, 4.70 per cent milk sugar, etc. "Well," says he, "I don't care for these other compounds; show me how to feed for the butter alone." I replied that I would do so if he would find me a cow that gave milk composed of butter fat alone.

The composition of milk should teach us, approximately at least, how to feed. We cannot get the butter fat without the caseine, sugar, etc. Hence, we feed a balanced ration, one that is sufficiently composed of albuminoids to enable the cow to produce milk, which is a balanced food of itself. You feed a balanced ration; you get back a balanced food. There is no such thing as a horse which has two trotting legs and two running legs. Whether he runs or trots he must be fed for all four legs. It is so with the idea of feeding for milk. The cow must have access to food abounding in the right elements for the production of milk. There is a great deal of significance in that word "balanced."

If you are fattening a pig which has attained its growth, you feed for fat, and corn meal will do the work well. In that case you have but one object, the production of fat. But if the pig is not full grown and you feed a fat-producing food, you at once hinder growth and development of the carcass. To get that development you must feed sufficient muscle and bone producing food. This sort of food is known under the three names of nitrogenous, albuminoid and protein, all practically meaning the same in their effect on physical economy. Now, milk was not originally designed for your consumption or mine. Its original purpose is for the offspring of the cow. If you put yourself in the calf's place it will not change the purpose of nature. Milk is, as I said before, a balanced food product and requires a balanced ration. In butter making we make direct commercial use of only one part, the fat, but we must feed for the production of all the constituents in the milk. To this end it becomes necessary to select largely of foods that most abound in albuminoids. These are cotton-seed meal, oil meal, pea meal, bran, gluten meal in grain, etc. There is another reason why the cow should have plenty of nitrogenous or muscle and nerve supporting food. And I invite special attention to the reasoning along this line.

I have said that milk giving was a maternal function. This function draws very exhaustively from the nervous forces and system. The cow that produces a pound of butter a day and other accompanying solids has drawn more on her nervous force than the ox who pulls at the plough all day. For this reason she must be handled so as to *prevent nerve exhaustion*, and fed so as to support the nervous system. The protein foods are essentially nerve and muscle supporting, and if a good cow produces milk profitably she must be fed an albuminoid ration. Sancho Panza said: "It is a great waste of lather to shave an ass." He was right. By the same token it is a great waste of good food to pour it into a poor cow. There is one practical way for every man to determine whether he is boarding a poor cow or a good one, and that is by the use of the Babcock test.

### INDIVIDUALITY.

It is very essential for the feeder to secure as soon as possible a judgment of each cow individually. There is nothing in the whole game which plays a more potent part with food and result than *individuality*. Every cow is not a heathen, but, like the heathen, every cow is a "law unto herself." Nancy Hanks trots a mile in 2.04 on twelve quarts of oats. That is the speed product of her food. Think of that wonderful result. Think of the millions of dollars that have been expended to achieve it. Think of the intense effort expended in the study of breeding, environment or proper handling and care. Think of the intense education of the trotting horse driver to give him the right judgment and skill. Sum this all up and then tell me if you can measure the problem of making a first-class trotter by twelve quarts of oats a day. It can't be done. Then imagine a man taking a Norman or Clydesdale horse, weighing 1,500 pounds, and trying to make a trotter of him by pouring oats into him. You cannot imagine it, can you? No. Why? Because there is not a farmer in the land but knows that breeding and handling are vastly more important factors to success in trotting than feeding. Not that food should not be considered, but you can find tens of thousands of farmers who have just that Norman horse stamp of judgment about cows.

In the address of William Widmann before the Wisconsin Dairymen's Association on the subject, "How we handle our dairy to get 306 pounds of butter per cow," which was published in "Hoard's Dairyman," occur these significant words: —

> Having concluded that it [dairying] was the most profitable branch of farming, we began taking better *care* of the cows, made the stable more *comfortable* and warmed their drinking water, etc.

Again: —

> On the 1st of October, 1891, the proprietor of the factory started the system of paying for milk by the *test* plan. It developed that our milk only yielded 3.9 pounds of butter per 100 pounds of milk. Being *dissatisfied with so low a yield*, we tested

> our cows individually; *sold* a number of the poorest, and started a *search* for butter-producing food.

I have italicized the following words in the foregoing quotation, *care*, *comfortable*, *test*, *dissatisfied with so low a yield*, *sold*, *search*, and desire to call your attention to the fact that they constitute the key-stones to the development of Mr. Widmann into a successful dairyman; and what this mill of education has done for him it will do for me, for you, or any other man who submits himself to its logic without conceit or prejudice. Here is a bit of his personal experience that may prove interesting: —

> Not having much land for pasture that summer, we concluded that feeding grain was necessary. We fed about two pounds cotton-seed meal and bran as long as the cotton-seed meal lasted, which was until July 1, after which we fed nothing but bran. The omission of cotton-seed meal resulted in a decrease of both quantity and quality of milk. We have concluded to feed grain in summer hereafter. It will take less land for pasture.

(How many think of that? Sometimes we cannot help ourselves; our pasture is of such a character that it is not worth much for anything else.)

> The cows will do better — not go dry as long — be in better condition the following winter. The largest average daily amount of milk and butter we ever received was the following October, while they were feeding on new seeding of clover during the day, kept in the stable at night, and fed twenty pounds of ensilage, three pounds of oil meal and four of bran.

Note this combination: succulent food, clover and ensilage, with a strong ration of milk-producing solids, and keeping in the barn at night, so that the chill of night air, in October even, should not detract from the profitable action of the milk-producing function. Here we see clearly disclosed the working of certain principles.

Again: —

> We endeavor to give to each cow in the herd our personal attention, and feed them *individually*, according to the *capacity* of each.

I have italicized the words *individually* and *capacity*. I quote the summing up of this talented young dairy farmer in the following two paragraphs at the close of the address.

He is a German boy raised in the city of Fort Atkinson, his father a wagon-maker, and was put on a farm, and shames nine out of ten of the farm-raised boys of that county. There is something queer about this life, anyway, isn't there? He has a masterful sense in his business. He says: —

> We estimate the cost of keeping a cow at $40 a year; $20 is for grain, $11 for ensilage and other coarse feed in winter, and $5 for grain and $4 for pasture in summer.
>
> For the calendar year ending Dec. 31, 1892, our cows gave us 179,936 pounds of milk, giving us a credit at the factory for 7,801 pounds of butter. This was an average yield per cow of 7,455⅔ pounds of milk and 325½ pounds of butter.

Understand, these are the figures taken from the creamery books, and not private record. The gross cash returns were $73 per cow. The skim-milk was returned to him, he making no account of it in this calculation, though it was made profitable in another way.

Turn where you will, you will find it a wonderfully broad field, one that will take all the brains you can muster to explore. It is something like that field that the farmer started to plough with a team of unbroken steers. They went hither and thither and he could not control them, so he set in the plough and said, "Go where you are a mind to; this field all needs ploughing." Don't look at it cheaply; don't think you need not exercise the very best intellect, the best honesty, and the best training you can secure. It requires more brains than politics (the Lord knows that, and so do I), more honesty than banking, and more trained thought and skilful hands than running an engine. To promote all these to their best fruition is what we are here for.

### Dairy Education.

Because a man keeps cows, is no sign whatever that he is a successful dairyman. In the eight Hoard Creameries about Fort Atkinson, Wis., are nearly six hundred patrons. Every man has an equal chance with his neighbor, for all are paid for their milk by the test value. The butter all sells for the same price. Yet there is a wonderful difference in the result per cow and per 100 pounds of milk, and finally per pocket. Here is one man with an average of nineteen cows, nine of them two-year-old heifers, whose average yield of milk per cow at the creamery was 4,796 pounds, producing 289.53 pounds of butter per cow, and for which the creamery paid him for the year an average dividend of $1.36 per 100 pounds. Here is another man that is contented with less milk per cow and an average annual dividend of 97 cents; another with less milk and a dividend of 96 cents; another with less milk and a dividend of 93 cents; another with less milk and a dividend of 91 cents. The first man is a dairy student. He reads and studies the experiences of other men. He is not bound up in his own conceit. He realizes the fact that success with the cow is very largely a matter of good judgment, and that to exercise good judgment he must study and educate himself on dairy questions. You can judge for yourselves whether it pays or not.

Two years ago I visited the Milk Condensing Factory at Dixon, Ill. The superintendent had the figures per cow concerning every patron. A few will serve to illustrate this point. One herd of 45 cows gave an average of 4,055 pounds per cow, receiving therefor $42.39 per cow. Another of 46 cows gave 5,630 pounds per cow, receiving $60.56 per cow. A number of other herds averaged over $70 per cow. The price of milk was uniform to all, being 90 cents a hundred in summer and $1.30 in winter. I published the facts, and the men concerned read them. They were amazed at the difference. ("Many are called, but few chosen.") A few saw at once the value of making a comparative study of others' herds and methods, and enlarging their knowledge and judgment by the experience of other men. The rest, however, kept on in the good old way of indifference and sublime faith that the Lord would somehow be good to those who despised knowledge. There was a time when the Lord winked at ignorance. That was in a former dispensation, however. A larger and better exercise of intellect is the one thing needed in this dairy business, East and West, North and South.

The CHAIRMAN. I see assembled here upon this occasion more practical dairy farmers, more creameries represented, than I ever saw before in Berkshire County or in the State of Massachusetts. We have, gentlemen, about two hours to comment upon and criticise the interesting address to which we have listened. I hope the gentlemen will avail themselves freely of the opportunity, but I will ask you to limit your remarks to about ten minutes, as there are a great many here.

Mr. M. I. WHEELER (of Great Barrington). The lecturer stated that the quantity of milk was decreased in consequence of exposure to storm in summer. I would ask him whether that was due to the effect upon the animal or to its effect upon the feed that the cows took, whether the added moisture to the grass does not so reduce it rather than the effects upon the animal herself.

Ex-Governor HOARD. There is a great deal about this question which I do not know. I am not able to say, but both might exist. I am convinced that the chief factor was the effect upon the animal herself, for the reason that corresponding experiments along those lines have shown me — and I think you, Mr. Wheeler, will remember it, if you reflect — that any disturbance of the comfort of a cow has an effect upon the character of the milk. When a long storm ensues and the cow gradually begins to feel a sense of discomfort, there is a disturbance of nervous action, and nervous action has a wonderfully quick influence upon lacteal secretion, and particularly upon the butter-fat content, which is the most variable of all the contents of the milk. Therefore I reason that this was due largely to the disturbance upon the cow herself, and may be that in affecting the food it did the same thing also.

Mr. WHEELER. That question was suggested by the fact that I read a great many years ago in the "Country Gentleman" an article by Mr. Atkinson, in which the writer asserted that shade trees in a pasture were an absolute disadvantage to cattle that were pastured there; that in the summer they were seeking their own comfort under the shade trees, and they filled their stomachs with the grasses which were reduced in concentrated food elements by the dews of the night and morning; that the cattle, when they were not thus situated, had more concentrated food than the grass furnished, with the moisture that came to it through the night and through the storm. That was the teaching of that day. Of course, that was a good many years ago, and new ideas and better knowledge prevail to-day in many respects, whether in that or not is a question.

Ex-Governor HOARD. That is another question. This is a specific question brought out by the Babcock test upon the milk of the cows in my creamery. Always following a severe storm there is a decrease in the fat content of the milk. I am not speaking about the question of the cow lying in the shade. That is a question to be separately considered. Whether the cow gets lazy and seeks the shade and does not do half as much as she ought to, or whether the heat is a cause, I do not know. There has been some investigation made by the Vermont Experiment Station, which the Commissioner here, Mr. Whitaker, has very finely brought out, showing that as the heat increases above 76° there is a decrease of butter fat contained in the milk. The effect of a rainstorm upon the decrease of the average butter fat of all the herds represents something like six hundred.

Secretary SESSIONS. You mean the decrease is in the butter fat of the milk following a storm?

Ex-Governor HOARD. Yes, sir. Suppose a storm occurs to-day, and all day long there is a pelting storm. At night the cows are milked and the cream is brought to the creamery and is tested to-morrow morning. It will show at once that there has been a decrease of butter fat. I reason that it is attributable to the fact that the cow is made uncomfortable, and thereby nervously disturbed.

QUESTION. Will it show any decrease in milk?

Ex-Governor HOARD. Not as much; still some decrease in the quantity of milk; but it will mainly show in the butter-fat content.

Dr. PIERCE (of Vermont). Does not the heat and effort of feeding affect the nervous system and disturb it, causing the same discomfort as a rainstorm?

Ex-Governor HOARD. I reason so.

Dr. PIERCE. I think every physician here will recognize the speaker's position when he speaks of the comfort of the animal.

Ex-Governor Hoard. I never have any difficulty in being understood by physicians and women.

Dr. Pierce. Last Saturday I was in the village of Millington, in this State, where I came across a very fine illustration of what has been given us this morning. I met a gentleman, a common farmer by appearance, and not quite the average of the common farmer. I was listening to the banter of a number of other farmers in regard to his taking care of his cow, and especially one who sold him the cow. She was a grade Jersey. When he purchased the cow she made a pound of butter a day. That was all that the seller had guaranteed the cow to do. They were laughing at him because he was spending so much time on her; but the cow was making seventeen pounds of butter a week. I listened to the banter a while, and I asked him what he did. "Well," he said, "I will tell you about that. I read 'Hoard's Dairyman,' and take pride in the care of the cow."

Mr. Kline (of Egremont). In connection with Mr. Wheeler's question about rain affecting cows, decreasing their product on account of a storm, this circumstance comes to mind. There was a butter and cheese factory in this county a few years ago, and the manager of it told me that always in an east wind the product of the cow was quite a per cent less than in a north wind, even if there was no storm. This manager said he could always tell by the wind what the product was going to be the following two or three days.

Secretary Sessions. That was in the quantity of milk?

Mr. Kline. No, in the per cent of butter product from the milk. He said it would be always less with an east wind than with a north wind.

Ex-Governor Hoard. I have had no experience in that line. I have made no observation distinctively.

The Chairman. Apropos to that question, I will say that, according to the report of the superintendent of the creamery for two successive years, it took a larger number of spaces to make a pound of butter in the month of September than it did in any other month; that is, it took nearly or quite seven spaces to make a pound of butter, whereas the average of other months was a little over six. I believe I make the statement correctly. I want to ask why that was so in that particular month?

Mr. KLINE. My idea is the cattle were eating too much frozen grass.

The CHAIRMAN. We have another superintendent of a creamery just over the line in the Nutmeg State, who perhaps can tell us something about this subject, Mr. Gold.

Mr. T. S. GOLD (secretary of Connecticut Board of Agriculture). I will merely suggest that Governor Hoard's position in Wisconsin does not enable him to understand what an east wind in New England is, and what it means to everybody, and it means the same for the cow. It is a wind that generally produces disturbance of all our mental and physical qualities. It makes us uncomfortable. Here it is the uncomfortable wind of New England, and it follows right in the line here that a cow should shrink in her milk, as Governor Hoard has said, whenever she is made uncomfortable. Why should not the east wind make her uncomfortable, just as it does humanity?

Mr. HORTON. We had occasion in the last six months to make investigations concerning a fly which troubled the farmers of Massachusetts. Mr. George L. Clemence has had some experience which seemed to me to do away with the fly at very small expense, and for the benefit of the farmers present, with your permission, I would like to have him give you a sketch of it.

Mr. GEORGE L. CLEMENCE (of Southbridge). In the fore part of August my herd had been very much troubled, not only with the common fly, but with this new pest called the horn fly. About this time a friend of mine sent me a device to try on my cows, an instrument for spraying cows with kerosene oil. He said it kept the fly from his herd, and advised me to try it. I did so, and with the very best results. The device is a simple spraying instrument, and I found with about half a pint of kerosene oil, costing less than a cent, that I could spray twenty-five cows inside of five minutes, killing the fly, and the cows.

would not be troubled again for an hour and a half or two hours; and I found that it is not only a great comfort to the cow, but also favorably affects the yield of milk. I sprayed the cows in the morning, but you all understand very well that kerosene oil evaporates very quickly, and it does not last probably more than two hours. A very small quantity can be used. It kept them as quiet as in the middle of December or January. I let them out after milking, and when they are returned to the stable I again use the sprayer. I supplement their pasture feed with oats and peas.

The CHAIRMAN. I see Mr. Sanborn present, and I would like to hear from him.

Mr. C. E. SANBORN (of Boston). I believe I was never called upon before or ever spoke in public, but I must say that this discussion in reference to flies has been of great interest to me in view of the experience which I have had in the last two years. I have quite a large stock farm, for New England, of horses, and during the season of 1892 in Maine we were troubled more than usual with flies of different varieties. My stock would come in from the pastures simply worn out from fighting flies, and required a good deal of extra feeding. I was recommended this season by an old veterinary to use rancid fish oil with boiled sage. The boys went into the pasture with a pail and an old paint brush and put some of this on the animals, in two or three places, perhaps once in three days, and they were free from the trouble of flies. You could see them feeding all day long in the sunshine, and we had no trouble whatever.

Mr. HARTSHORN (of Worcester). I would like to know why the use of fish oil would not be beneficial on milch cows.

The CHAIRMAN. I would like to ask Mr. Clemence as to the use of kerosene. Did you discover that it had any effect upon the milk in any way?

Mr. CLEMENCE. Not a particle; but I found that if you sprayed the cow immediately before milking you could smell kerosene in the stable, although I never detected it in the milk. But it seems to me that it would be advisable to wait ten or fifteen minutes after applying the kerosene before commencing to milk. By that time I do not think you will have the smell in the stable.

Mr. Nye (of Barnstable). I remember we used to use whale oil when I was a boy, but I think that it cannot be used on cows to advantage. The odor remains a long time, and I should hesitate long before I used it on a milch cow.

Mr. Wheeler. On this question allow me to say that the New York Experiment Station recommended train oil to be applied to cows, put on with a brush, and I tried it with very satisfactory results. I do not know what it is exactly, but it is known in the market as train oil, and it has very little, if any, odor, not enough to be perceptible — not enough, certainly, to have any influence upon the flavor of the butter.

Mr. Hartshorn. I used last summer three quarts of fish oil with one ounce of carbolic acid, in that proportion, with excellent effect upon my cows with reference to the horn fly; but it has to be vigilantly used, for the flies get there at any possible time and place. It was the first appearance of the horn fly in our county last summer.

Mr. Pratt. What is the description of the fly?

Mr. Hartshorn. It is very much like a half-grown house fly, a very small fly. The flies will stand right on their heads in the hair until they are filled with blood. They get upon the shoulders and neck, and I never saw anything more persistent in sucking blood out of an animal than the horn fly.

Secretary Sessions. We have them in various places in the Commonwealth.

Mr. West (of Hadley). I would like to ask Governor Hoard if he would give the same ration of grain in the summer that he would in the winter. We have a silo. Will he give us a ration for summer treatment of grain?

Ex-Governor Hoard. You should feed according to temperature. In the winter time you have to feed a larger proportion of food that produces fat, because you must maintain the temperature. In the animal economy we burn food to keep up bodily heat as we burn wood in the house to keep up heat in the winter; and I do not know that there is any difference in the process of combustion inside the body than there is out, but we must keep up the heat; therefore a winter ration, as a rule, should contain a larger proportion of heat-producing matter, of starchy food. In the summer time we have this outside heat provided for us; therefore the summer ration should contain a larger proportion of the muscle and nerve supporting food, the albuminoid food, and in that conjunction I do not know of anything that is much better than that ration which Mr. Widmann used — that is, bran and oil meal, or pea meal, or cotton-seed meal. I feel a little dubious about handling cotton-seed meal, though I think it is a very valuable food; but I have to handle it with some care.

Mr. PRATT (of Middleborough). I have been accustomed for many years to feed very heavily with cotton-seed meal in making milk for the Boston market. I have now become connected with a creamery which from the very first day of its operation and for several years has had an established reputation for making a very fine quality of butter, and they get a very large price for the product of their creamery. Now, in their regulations they forbid using cotton-seed meal or anything of that nature. Is it wise for them to allow it to be used in small quantities? No one furnishing cream for the creamery is allowed to use any cotton-seed meal, gluten meal, or anything of that nature. As I understand it, they have an idea that it will flavor the butter.

Ex-Governor HOARD. My experience does not coincide with this rule. I make butter for 3,200 families in Chicago; I supply them every week, and I do not believe that any man in the world has more critical customers. If you could see some of my correspondence you would say so. I am accused of about everything on earth except of being an honest man, the people declaring that I am serving them oleomargarine and all sorts of things. In the main I have a very fine class of people to work for, whom I appreciate very highly. There are a few cranks among them, but I do not believe anybody has a more sensitive demand to satisfy than I have, and I would not under any circumstances institute such a rule; but I would insist that either cotton-seed meal or oil meal should be used in small quantities, and that it should be used carefully.

Mr. PRATT. How many pounds per day can be allowed?

Ex-Governor HOARD. Not to exceed two. Maybe I can indulge in a little reasoning which will help on this matter. All of you know that the stripper's butter is deficient in flavor. You know that after gestation has set in — six months, say — the process of gestation takes out of the butter all flavor, and feeding cotton-seed meal in large quantities produces fat to such an extent that it is almost the same as strippers' butter. Now, that does not show that a man should not use it with temperance and with judgment. A small amount of cotton-seed meal is a help in the promotion of this albuminoid property that I am speaking of, but it should not be used as largely as some men use it. Then in regard to this matter of flavor, I will guarantee that this creamery you speak of will find the same difficulty if they should make butter from all strippers' milk. Supposing every cow had been six months milked or eight months milked, that creamery would find it impossible to make a fine article of butter. It cannot be done. I never could do it. What is the cause of that? There are two basic fats in milk. The flavor in the butter is largely the result of the butyrine and caprone, and gestation takes that entirely out, and so in regard to feed. I do not think that cotton-seed meal, handled rightly and moderately, will do butter any hurt. It does not hurt mine; but I have insisted that it should be used carefully. I have had no experience as to gluten meal that leads me to believe it is any more harmful than bran, but it is a very high protein food, and those protein foods can never be used as largely as a great many men want to use them. You must use a larger bulk and balance that ration. Then another point on feeding. I have never been able in my experience, with not more than one cow in a hundred, to secure any profitable results with above eight or ten pounds of a well-balanced ration. I had one instance with a Jersey cow that would take fourteen pounds of corn meal and six pounds of bran and return me a pretty fair equivalent for it, and an examination of the excrement showed it was digested.

Mr. PRATT. Governor Hoard, can you give us the correct proportion of the feed?

Ex-Governor HOARD. I cannot do it. I cannot look at your cows right here. From eight to ten pounds is about the range of profitable return. Above that there is an increase in the percentage of waste, and I cannot secure one cow in fifty that has a digestive limit above eight pounds. I think I can breed such a cow, if you will give me time.

Mr. Pratt. How would you divide that eight pounds — in what proportion?

Ex-Governor Hoard. Well, I would have two pounds of protein to every cow of a thousand pounds weight. For instance, I would take two pounds of cotton-seed meal, or a pound and a half. I would take four pounds of bran, and a pound, say, of oil meal, and the balance more bran.

Mr. W. B. Barton (of Dalton). In the Berkshire Agricultural Society we had before us six butter cows. We were under instruction to test them with the Babcock test, and take into consideration the time of being in milk and pregnancy, etc. Those cows had been in milk from three weeks to six months, except one, which had been in milk three or four years without having had a calf. The test resulted from about 4 per cent to a trifle over 8 per cent butter fat, and the quantities of milk varied as much. The cow which gave the 8 per cent of butter fat was this cow which had been in milk so long. There were five premiums awarded, and we excluded the cow which had been in milk three years from the premiums on the ground that that was not a butter cow, because the cream we considered would not be as churnable. I would like to ask Governor Hoard about that.

Ex-Governor Hoard. Was that a farrow cow?

Mr. Barton. Yes.

Ex-Governor Hoard. Farrow cows' milk, as a rule, as well as strippers' milk, is a little more difficult of churning, but not necessarily unchurnable. If you ripen the cream of such a cow or a stripper cow and carry the acidification a little further, you produce a corresponding ease of churning. I should not have excluded the cow you speak of on the grounds you mention, because churnability is more a test of the skill of the churner than it is of the cow.

Mr. ———. In regard to warming water for dairy cows, some three years ago this was called to our attention and we decided to make a trial of warming the water, although we were unable to get it to as high a temperature as we desired.

We could not raise it much above 65°, but we were satisfied that in our herd of twenty-five cows it increased the flow fully as many quarts per day. That was our first winter's trial. This fall, being called away from home considerably, I left instructions with my man that as soon as the weather became cold to warm the water. On returning to my home I found that the cattle had dropped off in quantity. I immediately inquired if he had warmed the water. He said he had not. When the water was warmed again, in two or three days they got back their milk, and increased, in fact, a little more than they were giving previously.

Mr. F. H. Plumb (of Springfield). The gentleman on my left has said that cotton-seed meal was not allowed in his factory, and Governor Hoard, who has fed it in the proportion he has stated, says it has no effect on the quality of the butter. I have been told by dairymen that cotton-seed meal has a softening effect so as to somewhat injure the shipping quality.

Ex-Governor Hoard. We know of no such effect; it is right the opposite. Oil meal has somewhat of a softening effect, and gluten meal is supposed to have that effect to some extent.

Mr. Plumb. Then there is one more question in relation to cotton-seed meal. What is its effect on the pregnancy of a cow when fed in large quantities?

Ex-Governor Hoard. Well, that is a mooted question. I could not say definitely. It is claimed it is somewhat disturbing upon the pregnant condition, and is liable, if fed in excess, to result in an abortion.

Mr. Kline. I have had some experience in our creamery. At one time nearly all of the dairies had been in milk a long time, and we frequently tested the different dairies separately, and we found we got a very poor yield of butter, but by mixing these dairies with the others we almost always got more per cent of butter from the whole mixture than we did when they were not mixed, so I think that by mixing the product of several cows or dairies it does away with that difficulty.

Ex-Governor Hoard. Very likely; the good helps out the bad.

Mr. Kline. In regard to cotton-seed meal, we have tested dairies that were feeding cotton-seed meal. It was claimed by some who were not feeding it that we were injuring our product, but our best judges have decided that the dairies that were using cotton-seed meal produced the best results.

Ex-Governor Hoard. I think they produce the largest result in fat.

Mr. Harwood (of North Brookfield). The gentleman in front of me asked a question, and Governor Hoard has answered it; but perhaps a little explanation further from me will be allowed. The gentleman is, if I understand it rightly, a patron of a co-operative creamery, and the Governor is the proprietor of a creamery. Well, these are two very different institutions. It has been found necessary with all the co-operative institutions in the creamery line to establish a certain set of rules and regulations to govern all their patrons alike. Some patrons might be disposed to do the fair thing, but they all do not look at it in the same light; consequently it is necessary to draw up a set of rules and have them rather strict in order that all shall do the same thing. Our experience where the patrons fed cotton-seed meal was this: if we allowed it to be fed at all, it would be fed by some patrons in very large quantities, and those to whom we shipped the butter for sale told us that it not only hardened the butter, but it gave it an oily look upon the top of the tub, and therefore reduced the price. I have answered the question in that way because it is a little different, and under different circumstances from that which the Governor had stated.

Ex-Governor Hoard. You did not find that cotton-seed meal had any effect to soften the butter?

Mr. Harwood. No, sir; and I found also that if we could trust our patrons to feed as we would be willing to have them, a small quantity of cotton-seed meal was not objectionable at all; but the fact that some would feed it to excess, and thereby injure the whole, obliged us to draw the line somewhere, and in drawing it somewhere we were obliged to tighten it perhaps a little tighter than was really necessary.

Mr. ———. I would like to ask the Governor if he has ever had any experience in feeding corn meal. The farmers in our section have fed it cob and all, mixing it with bran, and have had good success. Now, is it economy for the farmers to grind the cob, or shell the corn before carrying it to the mill? The past year I had a good crop of rowen, which I fed. After my rowen was gone I substituted gluten meal. It did not increase the flow of milk, but it added to the quantity of cream. I was told that rowen was not worth harvesting.

Ex-Governor HOARD. I never could determine whether the cob had any practical effect on the meal except a mechanical one, that of lightening the meal in the stomach. I never could discern very much nutritious quality in it, but I think there are many saints who do not wear crowns, and I think there are many influences in digestion which are not included in nutrition. I believe many things are useful, and the mechanical effect of keeping the whole food from impaction, from becoming pasty in the stomach, is a good one. You feed rowen. Rowen is dried grass, not hay. It has none of the woody stock; it is the finest food in the world, because grass is the finest feed, and the man who says that rowen is not worth saving should at once take steps to escape the judgment to come. I do not know why men reason as they do. To determine the effect of croppage, I took a lawn mower and cut two-inch grass and fed my cow on it, and she never would make more butter than she would on a plenty of nice croppage, June grass croppage. I desired to know how much she would eat, when she had all she wanted. Nobody had ever made the experiment. So I weighed it, and found she ate eighty pounds a day in the stable, and she gave me her return just the same as she did grazing outdoors. At the same time I dried a corresponding quantity, the same number of pounds, dried it thoroughly; it made from twelve to sixteen pounds of dried food. I fed that to the cow, and she dropped right down. Gentlemen, succulence hath a value not recorded in the philosophy of man in its effect upon digestion. Succulent food has a pleasure and palatability about it, and it affords solace and satisfaction to the cow.

The CHAIRMAN. I would like to hear from Mr. Bullard, one of our old farmers.

Mr. James Bullard (of Lee). I supposed we farmers came here to learn from these teachers that are paid by the State of Massachusetts, and I have been eagerly listening and learning. I have had some experience in dairying. I have but a small place, forty acres of land, and I have practised keeping some sixteen or eighteen cows, and have fed them in the summer. No one has yet told me that I could afford to feed my cows in the summer to compete with those that have pastures, but that is the only way that I can do. I wanted to use whatever tillable land I had, and I have found that I could feed these cows more cheaply in the barn. I have not yet found but a very few of us here who practise that method, and I only judge by my own ideas of the matter in raising feed in the room of sowing grain to mature. I have sowed about three bushels of oats and a bushel and a half or two bushels of barley, and as much more of peas, on an acre, and I have found there is more feed on that acre than there is on two or three acres of hay grass. The comfort of the cow which has been alluded to I believe in. I think I read in some paper, and I guess it was "Hoard's Dairyman," that at some dairy association one gentleman was asked about the treatment of his cows. "Well," he said, for short, "I think we should speak to them as we are under obligation to speak to a lady." That is, they should have our confidence. I had one rather young creature which was frightened by a dog while I was bringing her home, and she was wild for a while. I took it upon myself to pet her, and I can go in by the side of her now without her having any appearance of fear. But still when a stranger comes round she eyes him pretty closely, showing that there is a good deal in this idea of friendship. For three or four years past I have not allowed my cows to be *driven* to or from the pasture. The pasture gate is a short distance from the barn at the head of the lane. The cows go to the pasture by themselves. When milking time comes we put some grain in the manger of the stable where we wish the cows to stand and then go and open the gate, returning in front of the cows. They are always ready and come promptly to their places without excitement or fear, and I believe that I get a better quality of milk and more of it by this method of dealing with the cows.

Mr. Stetson (of Lakeville). I would like to ask Governor Hoard what form of fastening he would recommend while cows are in the stable. I see he objects to rigid stanchions, which I do myself.

Ex-Governor Hoard. The question is asked, what form of a fastening I would recommend? I am a little loath to state that, but I do not know that I ought to be. I have been experimenting for many years on a form of stable, and I adopted one about four years ago which satisfies me the best of any. This form I have published two or three times in the "Dairyman," owing to urgent solicitation, with explanations and cuts.

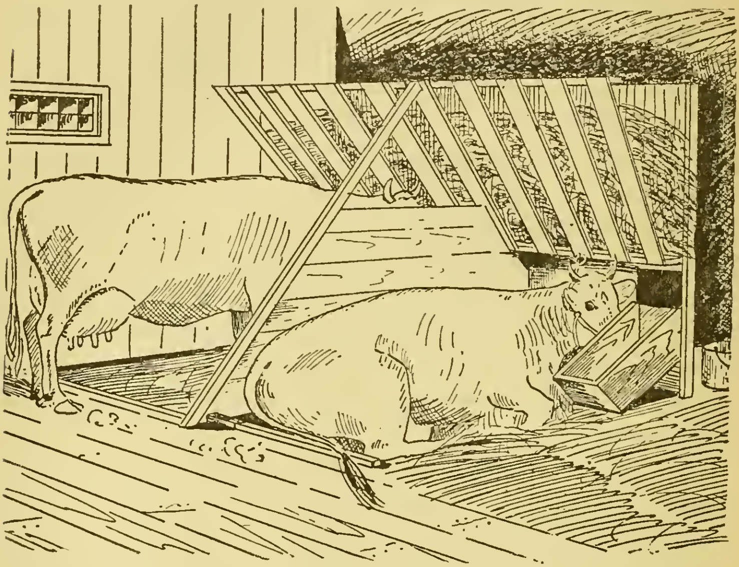
The excellence of this plan of tying cows over the stanchion plan is found as follows: —

(1) The cow has three and one-half feet in width of stall and perfect liberty and comfort of position.

(2) By virtue of the bar across the stall floor, which will be seen just forward of the hind feet of the standing cow, the animal has always a dry, clean bed to lie in, thus keeping her as clean from manure in winter as though she was in a June pasture.

(3) By this system each cow is protected when lying down from having her teats and udder stepped on by her standing neighbor. This is one of the most productive sources of injury that is known, and of itself should condemn the rigid stanchion.

The cut represents one row of cows facing another row. A closely boarded partition about four feet high forms the front of the stall. Each cow has three and one-half feet in width. The floor is made tight and there is no drop in the rear of cows, except the thickness of one plank, which is the double floor of the stall. The feeding rack is constructed for two purposes: (1) To contain any hay or roughage that may be fed the cow. The slats are put on wide enough so the cow can easily get her nose between them. (2) To force the cow when standing to stand with her hind feet in rear of the cross bar across the stall floor. In constructing the feeding rack nail a 2x8 piece of scantling edgewise against the board partition. This constitutes the bottom of the rack and should be placed about forty inches from the floor. Place the top scantling about two feet from the partition. This makes the feeding rack eight inches wide at the bottom and two feet wide at top. In the center of the bottom scantling fasten a ring screw to tie the halter to. Fasten the cow with a common web halter, she wearing the head piece all the time; the halter end of the rope has a safety snap to fasten into the ring of the halter under the throat. To prevent the cow from getting loose it is well to divide the end of the rope into two strands each six inches long and put a snap in each, fastening both into the ring when tying the cow.



View of New Cow Stall.

The grain and ensilage box is placed on that side of the stall opposite to the one the cow usually lies on. If she lies on her left side, place the grain box on the right side, as seen in the engraving. This box is large enough to contain the ensilage and grain feed, and is reached by an opening in the partition. It is best to have the feed box slant down towards the cow, so that all the feed will easily work down to the end nearest her. The box should be long enough to extend from the partition into the stall as far as the upper part of the feed rack projects and about eighteen or twenty inches wide and sixteen inches deep. If placed sufficiently slanting, the feed will easily work down to the lower end next the cow, so that she will not need to bring her hind feet in on to her bedding in order to reach the contents of the box.

In placing the bar across the stall bring the cow's head squarely up against the feeding rack; then just forward of her hind feet nail down a two-by-three scantling. Fill the space forward of the bar with bedding, which being without waste will last till entirely worn out. In this way each cow has her bed in true proportion to her length. It should be made fresh once a week, however, for the sake of health. I commend this stall to all dairymen who are looking for a clean, comfortable method of stabling dairy cows.

QUESTION. Do you provide any way for watering your cattle in the stable on this system?

Ex-Governor HOARD. Partially so. I have adopted the suggestion of another gentleman (we all learn from one another, you know), which I find very convenient. I am keeping but few cattle now. This governor business had a very disturbing effect on my cattle business. I am constantly trying to get back my self-respect and the respect of my cows. I had to part with my herd because of this disturbance largely. I have a few thoroughbred Guernseys, together with the cows of my patrons in the creamery. This system is not a perfect one, but it is the only system I ever found that would keep a cow clean and comfortable at the same time.

QUESTION. She cannot lie anywhere else; she has got to go up there?

Ex-Governor HOARD. She has three feet of rope. When she lies down she is not going to lie across that three-inch stick. She will try it two or three times, as you or I would, but she will give it up.

Secretary SESSIONS. Did you say that three-inch stick was just forward of her hind feet?

Ex-Governor HOARD. Just forward of her hind feet. As you bring her up each cow regulates that herself. The rigid stanchion makes them all alike. Go into any stanchion stable you choose and look at the cow lying on the floor, and you see a cow with her hips projecting clear over the gutter so the whole viscera is crowded down into the hips. The whole tendency of that is to produce weakness of the genital parts, and the consequent tendency to produce abortion. See the cow forced by the narrow standing place to throw the hind feet forward, the gambrels forced up under her, crowding the hind feet way up under her body and her hips projecting over the gutter. If the cow lies down naturally, the hind feet must stand out at a right angle with the body. With the stanchion system she is crowded up in this way.

Gentlemen, if you will study it — oh, if you will study it in the light of the cow, and not in your own light — you will get at a different view of this stanchion system. Bring the cow up here, and then in between this cow and her neighbor you can pass easily. You have a partition so that this neighboring cow shall not step over on the teats or udder of her companion, setting these two-by-four joists up in this way. With this method you prevent the cow from catching on the corners as she rubs, and you prevent one of the most productive sources to-day of injury to the teats and udder. I want to say to you, in my candid estimation, having investigated several thousand instances — my neighbors come to me constantly — I judge by my herds and from those of others, and I am all the time studying those things — I find, in my candid judgment, fully 75 per cent of all the injuries to the teats and injuries to the quarter are caused by the cows stepping over on to them as one cow is lying down and the other is standing up. Now, if I am right, to correct that evil would be a consummation most devoutly to be wished.

Mr. Russell (of Great Barrington). What system of ventilation do you use?

Ex-Governor Hoard. It is a pretty hard matter to tell which is the best system. We get at it in various ways, but the best system that I have ever seen is to construct a square box pipe running to the roof of the barn, and start that about two feet above the floor, with a damper such as you put into a grain conductor where you let down a supply from the grain box. The damper enables you to control the currents of the atmosphere. It is a little difficult to handle sometimes. I have noticed a downward current, and in that case you will lower the temperature too quickly. If I could introduce artificial heat into a stable I could accomplish the whole object of ventilation, because then by the heat I could secure a current of air. I know a few gentlemen who have introduced artificial heat, and they claim it is the best plan to secure perfect ventilation, but I have never tried it. I have never been convinced of the practical how of it. The thing to do is to arrange a plan that any common man can use, which is a pretty hard thing, and that is where my study comes in. Now, in the ventilation of a stable you have to warm the stable to a certain degree by the heat of the animals' bodies. Let me say you can help yourselves immensely by double boarding, by making ensilage walls with paper, and double windows, so that you can control the inlet of the air. You can let it come in where you want it to come in, and not come in in draughts upon the cow. Then you can arrange these ventilating pipes, carrying them above, and arrange your stable overhead tightly, so that the effluvia shall not go up into your barn, but go off into the air. Thus you will accomplish two things: you will carry away the vitiated air from your stable, and you will also be able to control, in a measure, the average temperature of the stable, keeping it at about sixty to sixty-five degrees.

Secretary SESSIONS. Mr. Russell has in use a plan of ventilation which we ought to learn about.

Ex-Governor HOARD. I would be glad to hear from Mr. Russell.

Mr. RUSSELL. I dislike to take a minute of the time, for I am so thoroughly interested in the practical experience of the other gentlemen whom I have listened to to-day; but I have given some thought and a good deal of attention to the subject of ventilation, and those members of the Board who were here some years ago, perhaps, will remember the demonstration that I showed at that time. I sought the advice of a gentleman who had been employed by some institution in New York, and had been sent abroad solely to study the subject of ventilation, and through him I adopted the plan which I will undertake to describe.

It is, in the first place, the cheapest construction of any ventilating apparatus that I have ever seen. He objected to an arrangement with the opening through the top of the roof into an ordinary cupola constructed of slats, as we commonly see. The wind blowing in all directions against it prevented a proper exit of the foul air. Therefore in place of that I put upon the back side of the stable a common rotary iron ventilator, so that the wind in striking it should cause an upward draught. Then I constructed, as described by the Governor, an air tube which commenced at about two feet from the floor of the stable. I ran that up inside the sheathing of the stable so that none of the warm air should be condensed by the cold air upon the outside of the stable. I ran that nearly up to the peak of the roof. I ran it up under this ventilator, giving a space of perhaps twelve or eighteen inches. This prevents the down draught which I had discovered by every other system. Now came the question of letting in the proper amount of fresh air, which was done by making openings directly under the ceiling of the stable. These little openings were fourteen inches in length and an inch and a quarter wide. They were covered with wire cloth to prevent being stopped up, and also had a little tin cover that could be opened and shut, and thus regulate the supply of air. I have never found it necessary to use these covers, as the temperature has never been too low with the covers wide open. Those openings are placed right around the stable under the ceiling, and fresh air from out-doors comes in through them.

Ex-Governor Hoard. Doesn't the warm air run out of those openings?

Mr. Russell. Not at all.

Ex-Governor Hoard. How can it help it up in the top of the ceiling?

Mr. Russell. Well, the air outside precipitates the warm air, and the foul air seems to go through the air ducts or ventilators.

Ex-Governor Hoard. But the warm air will go right up against the ceiling and stay there, being lighter, and if there was an opportunity all around the edge of the ceiling for the warm air to go out in that outer space, what would prevent it?

Mr. RUSSELL. Well, that seems so in theory, but it is not so in practice. I took a committee of this Board to this stable, which is thirty-six by forty on the first floor of the barn. I had at this time, I think, eighteen cattle in the stable. I had it thoroughly closed and kept closed until the Board came there. They said at that time that they never had been in a stable that was so free from animal odors. In a space of twenty-two by twenty-six I stable four horses. The stable is made tight, ventilated in precisely the same way, and if you will go into it I will guarantee you will hardly detect the smell of ammonia there.

Secretary SESSIONS. How is the temperature?

Mr. RUSSELL. The temperature of the cow stable is always above freezing. I should say it was about fifty.

Ex-Governor HOARD. Well, I want to save that ammonia. I do not want to ventilate it off.

Mr. RUSSELL. That is in the air. I save liquid ammonia.

Ex-Governor HOARD. Well, that ammoniacal exhalation comes from the urine, and is thrown off by evaporation, isn't it?

Mr. RUSSELL. It is thrown off by evaporation, but the ventilators take care of it.

Ex-Governor HOARD. I do not want them to. I want to save it.

Mr. RUSSELL. I am afraid that what would be saved from evaporation would be detrimental to the health of the animal.

Ex-Governor HOARD. That is right; but I will do something to absorb it and take it away from the animal. That is the reason why I use land plaster to sprinkle in the stable.

Now let me give an idea which you will clearly see. Take a male horse for instance. You step into the stable in the morning and shake up his bedding, and your nose will tingle and your eyes water instantly with the irritating effect that comes from the exhalation. It will take the varnish off of a buggy. In some barns it will take the blacking off of a harness, and it will irritate and injure the respiratory organs of our cattle or horses. It is a valuable compound, worth sixteen to nineteen cents a pound, and I do not want it to go off in the air and enrich my neighbor. I want him to get rich some other way. Therefore I take land plaster in connection with ventilation and see to it that it is absorbed, and then it is taken into the manure and held tightly, and I utilize it. I think you will find a wonderful increase in the fertilizing power of your manure if you will use land plaster freely, not too freely, behind your horses. It has a drying effect on the feet. You have to be careful about that, but in the stable and in the manure, and even in your barnyard, sprinkling it there constantly to hold the ammoniacal exhalation will aid you very materially in sweetening the air of the stable, and it costs but very little.

QUESTION. How much does the plaster cost?

Ex-Governor HOARD. A barrel of land plaster costs me $1.60, and I use a barrel to nine animals in one hundred and eighty days.

Secretary SESSIONS. I wish to announce that the Babcock tester will be exhibited after the afternoon lecture in this hall. The room where the dairy exhibit is prepared is too small for an exhibition of that sort, and after the afternoon lecture the Babcock test will be exhibited here.

Ex-Governor HOARD. I am requested to tell the story that I told once at Worcester, which would more particularly apply to the process of dairy education.

The story was related and will be found as told at Worcester, in "Agriculture of Massachusetts," 1890, page 124.

The CHAIRMAN. We will adjourn this meeting until 2 o'clock.

### AFTERNOON SESSION.

The meeting was called to order by the chairman, who said: The subject this afternoon is educational, "Judging Animals by Scale of Points." We will put ourselves now in the position of scholars and resolve ourselves into a kindergarten school, and our teacher is Dr. G. M. Twitchell of Augusta, Me.

Dr. TWITCHELL. Mr. President, ladies and gentlemen: About a year ago I had the pleasure of standing in this hall and speaking to the farmers of this vicinity upon "The Horse of To-morrow: Where shall we find him?" I remember very distinctly the afternoon, and how much I enjoyed the cordial greeting extended me by the gentlemen present, and the very favorable impression I carried away, not only of your beautiful village, but of the interest and intelligence manifested by those present. When the invitation came from your honored secretary asking me to come here and speak to you upon this question I felt a double incentive to accept. In the first place, the desire has grown with years to assist, if I could, in the solution of some of these vexed problems with which our New England farmers have to deal, and experience has strengthened the faith that through the scale of points we are to reach their solution, and then there was the other thought that I was sure of a heartfelt and cordial welcome upon my second visit, and therefore I at once accepted the invitation.

Since I was here, continuing my study of the horse problem, meeting as we have during the past year an increased depression in that class of stock, looking all the while for the animal which should meet the demand of the market and give us what will be wanted, I began the preparation of a lecture to be used during the coming winter, the illustrations for which you see upon the platform. Here are some French Coach horses. I sent a photographer to the breeding establishment in Maine of Mr. J. S. Sanborn of Boston, a few weeks ago, without Mr. Sanborn's knowledge or without the knowledge of the superintendent, and had these views taken. These horses were photographed just as they came from the stable and pastures, without any preparation, without any special feeding, and these enlarged solar prints are exact reproductions of the horse Gemare, which stands at the head of that breeding establishment, a native brood mare, and five of his colts. I brought these because there was some doubt as to whether we should be able to have an animal upon the platform this afternoon; also to show a type of road horses bred in Maine to-day.

# JUDGING ANIMALS BY SCALE OF POINTS.

BY DR. G. M. TWITCHELL, AUGUSTA, ME.

In the study of any economic problem bearing upon individuals and the State, or between individual and individual, the first thing to do is to come to a full understanding of all existing conditions and surrounding influences.

The danger of men working by themselves, in shop, mill, study, or on the farm, is that surely, if unconsciously, they become encased in the crust of habit, the hardest crust to break, the one most difficult to dissolve, and from which there is no relief save friction by contact.

Under this crust old methods and practices appear to be the only ones to pursue. With eyes blinded with this deposit, there can be no other path to prosperity save the narrow one traveled, no implement better than the one used, no class of stock, or individual thereof, more productive or valuable than those on the farm; and, worse than all else, no theory so good as the rut followed. The thought gets imbedded that books and newspapers are a curse rather than a help, the writers impractical men, improvement an impossibility, and every one who has broken away from old practices, a crank with one idea, who is surely on the highway to ruin.

Probably within five miles of where we now are there are farmers who cannot afford to take a day or half a day to attend these meetings. Their excuse is, " It don't pay." It pays me to go a hundred miles to attend a farmers' institute. God pity the wilfully ignorant!

All about us, in town, village and country, these individuals are to be found, barnacles on the wheels of progress, yet certain that they and their methods are to save the world, if it is ever saved, the "*if*" in their minds being a surprisingly large factor, while all the while the wonderful inventions of men are solving the problems of the day, promoting a higher life and rendering a greater range of comforts possible to the humblest, bringing all the mighty forces to do the bidding of the toilers of earth. The greatest obstacle to be overcome is the opposition of those who would receive the greatest benefit. I repeat, the only salvation for any man is by friction through contact, friction of mind against mind, ideas against ideas, thought against thought. Companionship with individuals is not to be compared with companionship with ideas. The weekly agricultural newspaper, alive to the demands of to-day, is as necessary for the salvation of the farmer as the golden rule for the salvation of man, the friction of brain against brain as essential in the development of the highest possibilities in any department of farm life as the quickening power of God's spirit to help up the hill of progress.

Get this thought firmly fixed that education is the fertilizer which alone can revolutionize New England farms. If conditions have changed we must change; if market demands have been transformed we must be transformed; if the great West is pouring its products down at our doors to compete with the home grown, the lesson is that out of developed brain power we may rise to higher attainments.

We are shut out in one direction that our energies may be directed towards the production of something better. The lesson is that universal law of growth. We are not crowded out, but up, if we will but through friction develop the power within us. So I count the present condition and future prospects a blessing to the farmers of New England who aspire to grow. He who is content to follow old paths, to keep in the ruts, will be crushed between the upper and nether millstones.

A horse is not a horse simply because it has the general form of that animal, a cow not a cow because she has horns and gives milk. Both are to be measured by their individuality. A clean-cut conception of the distinction here indicated is necessary.

It is only through discipline that man preserves his individuality; therefore it follows that by the same is improvement made possible with our animals. Thus we lose sight of the idea that a horse is a frame with the skin drawn over it, and begin to conceive of the possibilities of the animal in one direction or another, not in all. We begin to divide and subdivide. There follows an ideal of form adapted to the purpose, and the work of improvement, through education, has commenced.

It is the same with the cow, the sheep, the poultry, the whole range of animal, vegetable and mechanical products. The primal object of all exhibition and competition should be to fix this ideal of parts, with sole reference to purpose so clearly in the mind that, in measuring, the perfection of each shall decide the question of worth. There has been no desire here to discuss moral or ethical questions, but to present fundamental facts which have a direct bearing upon what is to follow.

We are to-day to discuss the scale of points as a means of determining value and deciding the question of merit at our agricultural fairs, between animals, farm, garden, orchard, household or mechanical products.

To discuss intelligently the fundamental purpose of these annual exhibitions must be considered. In the wisdom of the lawmakers, recognizing the supremacy of agriculture and the dependence of all classes upon it, it has been deemed expedient to incorporate, in the counties of this Commonwealth, agricultural societies for the sole purpose of furthering the interest in agricultural and allied mechanical pursuits, by providing for annual exhibitions, where premiums might be offered and paid on most meritorious animals and articles. To advance agriculture and promote mechanics was the purpose of the original act of the Legislature, and for this the sum of $21,000 was last year appropriated to the 35 incorporated societies of Massachusetts, not to be distributed over the several counties, not to be used alone to provoke competition, not to be paid out on inferior animals or products, but in accordance with the original act to "advance" and "promote."

It is perfectly safe to assert that under the committee system of awarding prizes all thought of advancing or promoting has dropped out of sight. Wherever the awards have been made under this plan the paramount idea has been to beat somebody, not to be educated. Committees have been selected on the grounds, and too often been exhibitors themselves, and the scramble has been to reach after and win the blue ribbon, regardless of results. This much may be claimed without reflecting in the least upon the honesty or integrity of any individual member of any committee. The criticism stands against the system, and for this reason, that a ribbon or a card does not, and cannot, advance or promote anything but the selfishness and self-interests of the fortunate individuals. There can be nothing educative, and education is absolutely necessary for growth everywhere.

The comparative system of awarding premiums is punctured with abuse on every hand. The fear of severe criticism from exhibitors, or the public, renders the position on the committee one to be avoided. In the presence of a large number of exhibitors in any one class it becomes a delicate and difficult matter to award all the premiums to a single individual, even though satisfied of superior merit, or on the other hand to pass by a wealthy and influential member, even though his exhibit falls somewhat below. There is wanting something definite, something tangible to which the committee may turn for complete justification. Another objection is the temptation to shift responsibility when criticisms arise.

At one of our fairs some years ago I overheard the conversation between members of the committee. When the class of three-year-old colts was called out, it was very apparent where the first award should go, and they gave it readily. When they called the two-year-olds it seemed that the man who won the prize on the three-year-olds was also entitled to it in this instance; but the remark was made by one of the three, "We gave him the first prize in the other class," and he did not get it in the second, because, as the chairman expressed it, "it would not do to give one man a first premium in two classes." The next day this gentleman, being disappointed because he did not win, hunted up the three members of the committee, and I went with him to hear what they would say, and each one of them said to him, "My dear sir, I did all I could to give you the award, but I was outvoted." Each one of them made that same answer. This little incident first called my attention to possible evils of this system, and led to the study of the decimal system and the benefits resulting from the use of the score card.

If the comparative system is to be continued, then one man should make the awards in each class. These objections are manifest and valid, but the chief reason why the State should require a different system, and insist upon its intelligent application, is that the defeated party knows not why he loses or the winner why he gains. The one may be content with the honor and the other retire without complaining, but neither has been helped to an appreciation of what is necessary for improvement by having the weak as well as strong features of their individual exhibits presented in detail. In fact, the committee awards too often encourage bad practices by strengthening selfish admiration for one's own stock, and blinding to its defects, and also discourage by failing to strengthen an appreciation of the good work already accomplished. There is, there can be, nothing educative under this system.

An agricultural society exists for three distinct purposes: —

First. To afford amusement and recreation.

Second. To stimulate production through competition.

Third. To educate, that agriculture may be advanced and mechanics promoted.

Competition, which is the prime factor in improvement, unless guarded and restricted, develops into a single thought of winning, regardless of justice or equity.

That competition may be made an educator, and thus a helper to better conditions, there is demanded the safeguard of the scale of points.

Thus from every stand-point it becomes obvious that it is the duty of the State either to withdraw its support or require that the fundamental principle upon which these societies were founded be applied.

From an outside position, realizing the grand work possible through these incorporated bodies, and the supreme necessity for its accomplishment, the work performed by this

State Board in perfecting the scale of points for the varied exhibits is not only most opportune, but to my mind necessary, to justify the continuance of the liberal stipend. It is a work so far above the level of that usually attempted that its influence will be felt all over the country. It tells of faithful, painstaking service on the part of the members and the secretary. It speaks volumes for their thoroughness. Rightly applied, it marks an epoch in the history of Massachusetts agriculture. It will be for the best interest of agriculture, throughout the Commonwealth, if the Board should be given power to insist upon the adoption of this system of awarding premiums, and make the payment of the stipend conditional upon its intelligent application.

By awarding all prizes and examining all stock and products under the decimal or score-card system, every exhibitor may have the evidence of merit, or cause of failure, to consider at leisure, in the detailed score-card. This may not insure any better judgment, but it furnishes all the evidence upon which judgment was based, and it is this, and this only, which will educate, which can advance and promote.

Every man who passes judgment on any article or animal, at any time or place, measures it by an ideal of his own. It may be imperfect, so vague as to be beyond description, yet to him it is a standard of perfection, and he approves or disapproves as the object approaches or falls away from that standard. You like a horse passing before you, but if I ask why, you cannot tell; yet in the glance you have measured by your standard, by your ideal. The one object gained through the decimal system of judging, above all others, is that it fixes this ideal of perfection by parts, sc that one becomes critical in judgment; he becomes educated.

When a committee goes out to award the premiums by comparison, it is presumed that this standard of perfection shall not enter in to influence judgment, but that the examination and comparison of individuals shall determine the awards. The advantages here are that the whole field may be examined together, and under the critical eye of the committee the awards made and ribbons attached in much less time than by the use of the score-card, on each animal; the objections — that the worth of each is measured by that of others, and the difficulty of carrying in mind the defects and their bearing upon values not appreciated, while the reasons for making awards, unless very obvious, drop out of mind as soon as the class is out of sight.

Against this I place the scale of points perfected for each class, the single judge, who shall affix his signature to every card, and the individual score-card for every animal of every breed, and for all products whether of the farm, field, orchard, dairy, shop, mill or home. Responsibility cannot be shifted here and no man will put his name to a card unless reasonably sure of the record he has made.

This means simply that the article or animal or product shall be divided into parts, each to be measured by itself, and to each part a fixed value shall be given to represent the standard of perfection as compared with the ideal, which is what one would have if that part could be made to suit one's conception of perfection. Thus in the horse, 100 represents perfection in structural parts, each having a fractional value.

We give four points to the eyes. If these be large, full, lustrous, expressive, indicative of developed brain power and increased brain capacity, telling of courage, and with lids free from meatiness, the credit would approach perfection. In seven years' experience, working with some of the best experts in the country, I have known but one animal to be marked perfect in eyes.

A critical examination always reveals something not desired. In case the eye is but ordinary the credit would be fifty per cent of the whole.

If I send a horse to the stable with a credit of two for eyes I have gone on record, and if any error has been made it can easily be corrected.

Suppose that two horses score the same in every other part, but simply because one has a meaty lid it falls one-half to one point below the other in total footing. Naturally the owner who loses raises the question, Why? and it is these whys which educate.

Bring the two horses together, compare them, point out the difference in expression resulting from the difference in thickness and flexibility of lids, because of that single faulty construction, and you will have set agents at work which will make that breeder more critical than would be possible in any other way, you have commenced the work of advancing and promoting.

At one of our county fairs the editor of a paper came to me and said, "I know nothing about this scale of points. Can you tell me?" I said, "I have not time to tell you, but if you will stand by my side while I am scoring, I think you will understand it." I did not notice that some of the owners were getting around me. I scored a colt, and they brought in a second one. As I glanced over the head I made the remark, "This eye is not as good as the other," and the owner said, "This eye is as good as any in the field;" stopping my work, I asked to have the other colt brought in, and while the man was gone I explained what I would have for an eye if I could form it and its surroundings. The colt was brought in, and when I put the two heads together, and asked the owner to compare eyes, he said, "I am a fool. There's a difference in eyes." Do you not see that I helped that man by giving him a few minutes' time?

In all operations two extremes are to be avoided; both are natural, depending upon the temperament of the breeders, growers, or manufacturers. One is to overlook defects and consider everything produced perfect, and the other to so magnify defects as to lose sight of real value. Both conditions are alike injurious to individuals and industries; both are promoted by the comparative system; both are remedied by the decimal.

Perfection in production has never been reached, and never will be. The only incentive to labor lies in the hope of future accomplishments. If the maximum of growth, production, speed or quality had been attained all incentive to improvement would disappear. The scale of points brings out the defects in detail, and while educating to a just discrimination of values, indicates what is necessary to every grower, breeder or manufacturer — that is, the weakest spots or parts.

One lot of apples fails in flavor, another in fibre, another in form, and it is only by placing a fixed value on each item in the scale of points and allowing the sum total to determine the award that all the facts can be brought home to the individual orchardists.

The comparative system would not reveal the imperfections in flavor or fibre to the looker-on, or to the exhibitors, unless all became tasters and tryers. One man finds his fruit cut in flavor and fibre, and at once the suggestion comes that pruning and cultivation and fertilization are necessary, that next year's crop may be improved.

How was it with the forty or more samples of butter at your last exhibition, all put up in attractive form and passed upon by a discriminating committee, who placed the honors where they honestly belonged? Did you who won ever know why your product was preferred to others, or you who failed why you did not win?

Was it flavor or texture, color, or method of salting and putting up which determined? What possible benefit can it be to you, either as winners or losers, unless you know the reasons? What incentive to improve when only the ribbons tell the story of preference?

Every card giving the detailed score, returned to the individual exhibitor, becomes a promoter of better practices, and an incentive to improvement — an educator.

Suppose some tidy housewife returned without a ribbon or a card telling of honors won, but on the score-card a decided cut in flavor, and at the foot a note, "decided barn flavor," a record possible in far too many cases. Think you she will rest until the cobwebs are swept from the tie-ups, floors made clean, cows groomed and bedding applied? The reflection on her skill caused by the slovenly practices at the barn will lead to decisive action and better outside conditions.

Show a man that the present mating of his mare is giving a heavy-headed class of colts, and the thought of a change will impress itself immediately. You cannot demonstrate that under the comparative system, and the fact that the mare is from a producing family, and the stallion used from another, is too often accepted as proof positive of value in the offspring, regardless of individual merit.

Only by a study of parts and a knowledge of the purpose of each, together with a high ideal of perfection, can the bad practices of present hobby-riding breeding be broken up. It has been the blind leading the blind which has filled our barns with stock of all kinds wanting individuality. The fact that so small a per cent of our colts develop into valuable roadsters, that the average milk and butter production in New England falls far below the limit of profit, while there is a sure profit with both, furnishes all the evidence that a change is called for which will educate to a different standard. The supreme excellence of the scale of points and score-card is realized only when every individual exhibitor is furnished with the detailed score of every animal, plate of apples, peck of vegetables, or manufactured product shown by him.

Beyond this the educative work possible at all our annual exhibitions, great and small, can never be recognized or secured until with the expert there goes the clerk, to place upon a black-board, where all may read, the record of each score as made by the judge. This publicity removes the last objection to the scale of points, and insures prompt questionings by interested parties.

As the work progresses and scores multiply on the blackboard, the causes for variation will be inquired into, and the animals should be brought together and the lesson fixed by comparison. The expert who cannot defend his score intelligently is not fit to perform the duties. Let discussions be encouraged. You cannot award honors to owners in such a field. There are many around as sharp as the judge, and they will be satisfied only when the whys are answered and justice is done.

The furnishing of a copy of the score of each individual exhibit to each exhibitor involves extra work on the officers, but the exhibitors who make the exhibition have the right to insist that this be done.

If the State requires a standard of perfection, as it should, in order for an award to be made, it should guarantee the score card to each exhibitor telling of the worth of his individual exhibit. Let the rule be established that a total of 75 out of 100 points must be obtained in order for a first premium to be awarded.

If agricultural societies are to continue and do their best work in developing the varied industries of a State, the best interests of the smallest and humblest exhibitor must be recognized. The tendency to concentration of exhibits and reduction in number of exhibitors must be prevented. No society has performed its task until every farmer within its limits is a regular contributor to the yearly exhibitions. Let every one be assured that the scale of points is to be applied to every exhibit, that each is to be measured by itself independently of all others, and that the score in every case is to be returned to the exhibitor, and the last barrier to a complete exhibition will disappear.

The objections raised against employing experts, or putting the work of awarding the honors in any class into the hands of a single individual, hold only in the imagination of the objector.

The task of judging by the scale of points is less arduous than by the old system. Having the card in hand, the judge attaches value to each part independently of all others, the total footing to determine the awards. Thus when one part has been passed and the record made, it should drop out of mind.

One thought should here be emphasized. If the credit against any section is less than the full amount given for perfection, the reasons for making the cut should be indicated either by checking that part or writing in the cause. Thus in the card for the horse, it reads: "Chest deep, full and prominent, good width," the standard being three points. If narrow, and the credit is one and one-half, the judge should underscore the words "good width," and then write in the word "narrow." Thus in every part care should be taken to make plain the causes for any reduction of credits.

It is this, and this only, which will fully make clear the work of the experts in the butter room yonder. For every cut for defect the full reason should be written on the card. If a sample of butter is too salt, instead of cutting for this the card should indicate that there is an excess. If the texture of a sample is imperfect, it should indicate what the texture is, and what it should be, in order that the man who made it may know just what the trouble is, and how to remedy the same; not that it fails in being up to the standard of perfection, but just in what way it fails.

I make this plea for systematic work in awarding premiums, and for extended and critical supervision by the

State, through the Board of Agriculture, for two reasons, either of which fully justify the claim.

First, because it is necessary in order to establish justice between exhibitors, and place awards in accordance with merit; and second, because of the imperative necessity for raising the standard of quality in all exhibits.

The day has gone when we may expect increased price for farm, garden, orchard or manufactured products. For years we have been approaching this lower range of values. Let no one fear that this or that industry has failed to be remunerative so long as the limit of production is beyond our comprehension and the saving in production an unknown quantity. Seeking earnestly, continuously, intelligently for the higher quality and lower cost, the margin of profit will always be assured.

Along this line and this alone lies the path of progress for the farmers of New England.

Against the bulk of the West we must set the finish of the East; against the volume from the prairies must be placed the skill of the older sections; against the quantity pouring into our markets — the great consuming centres of the country — must be ranged the higher quality which by keen study, close application and a just discrimination of the relation part bears to part, may be insured the growers and producers of the old Bay State. We cannot till a thousand acres at a net profit of $2 per acre, but we can till one hundred at a net profit of $20. We cannot produce a horse to weigh twelve hundred and sell for $80, as can the farmer of Iowa or Kansas, but we can produce a better animal, with a higher range of intelligence, greater brain capacity and superior road qualities, which, undeveloped, will sell for $200 or more.

We cannot, perhaps, grow 3-cent beef, but we can at the same cost grow 25-cent butter. The things we can do and the stock we can raise, the crops adapted to our time and climate, may all be made to give better returns and larger profits per acre, per pound or per bushel than is possible outside our borders. Hemmed in under certain conditions as we are, it is only that the higher levels may be reached. The man who finds the path to prosperity under any restricted condition must do so by the use of greater brain power.

This means the growing of better animals and crops and the making of better products by the exercise of a higher skill. That this may be forthcoming, we must sit down and fix definitely in mind the worth of each part and the relation it bears to every other part and to the whole. To do this with any approach to justice, measurements must be made by a scale of points, thus fixing value to every part.

In all farm products it is size, color, texture and flavor, whether onions or apples, potatoes or pears.

Bring out the dairy cow, and her value is to be indicated not by comparison with a beefy neighbor, but by what she is herself. Not size, or form, color of skin, shape of body, length of back; not expression of face, or fullness and intelligence of eye; not size and form of udder; not one of these can settle the question, but each and all. Behind the whole is the individuality of the animal. Beecher said: "Men are like trees: each one must put forth the leaf that is created in him; education is only like good culture, it changes the size but not the sort."

Just so with the dairy cow, and to learn the "sort" that we may increase the quantity is the lesson of the hour. As we begin this study we find that beef in the cow, draught form in the horse, meat in the pig and hen are all allied, while over against them are speed, milk or butter, and eggs. This distinction grows upon one as the merits of the scale of points are appreciated. We learn to divide and subdivide, to study functions as well as form, to measure tendencies and individual traits as bearing upon the one object, production; and the more clearly one is led to discriminate between a thief and a benefactor, the more rapid the growth of his steer and the larger the returns from his dairy cow.

Take for an example the horse, the best friend a man ever had, because he never talks back. Without the scale we measure value as a whole, but under it, the worth of what otherwise seems a minor part very often determines practical utility. Size, form, color, brain capacity as well as developed brain power, intelligence, docility, substance, endurance, all of which might be named under the head of nerve force — quality of skin, bone, hair and hoof, these are what one learns to look for, though only a small part are on the score card. These are to be the essentials of the horse of to-morrow, and when found will give value. It has been speed and speed alone.

To-day the perfected horse is called for, perfected for the road, perfected for long, continuous service. In the orchard and field, the home and the whole range of home manufactures, the scale, adapted to each class, becomes as valuable as among the stock and its presence as helpful to the higher education of to-morrow.

The future of Massachusetts agriculture will depend upon the future of Massachusetts agricultural societies, and their life and perpetuity rest entirely upon their ability to assist the inhabitants to a clear and satisfactory solution of the great agricultural problem of the immediate future, one fraught with significance to every native-born New Englander.

I have endeavored to show how this solution, which rests entirely upon the intelligence of the individual farmer and his co-laborers, requires that greater discrimination be used in determining the worth, the utility, the practicability, the possibility of each and every class and department of agricultural and mechanical products. It is not the financial success of this or any other society which is at stake, but the future of these farms; not the growth of the organizations, but the growth of that spirit of painstaking investigation which, rightly applied, will lead the young men of to-day to realize that here upon these farms, on these hillsides, up and down these valleys, with growing markets all about you, there are just as good opportunities for brain as well as muscle development, just as certain results financially, just as sure returns and a more perfect manhood than town or city can insure.

The farmer in New England who carves a future for himself in the next ten years will do it out of his brain, his hands being only willing servants. As a powerful aid and stimulant to the possible work and results I place the perfected scale of points for each class and department and urge its adoption by all agricultural societies and use by every individual.

We do not realize, my friends, the conditions in which we are standing. Who of you are worried about the food you are to eat this winter? And yet to-day there are thousands in Massachusetts who know not where the bread is to come from to put in their mouths to-morrow. Coming out here yesterday I was reading of the work being done in the city of Lynn, where they are employing men to do a certain number of hours' work each week in order that they may have food to keep them from starving. Thousands, yes, hundreds of thousands of dollars will be contributed by the wealthy during the next four months that thousands of men, women and children may be made warm and hunger appeased. All this in our own New England. The cry for food and heat will not be heard in the farm homes, but under the shadows of the great cities. Never was the lesson presented so vividly as to-day. Never did we realize as to-day the value or the dignity of these farm homes, or the certainty that Mother Earth takes good care of every one who intelligently seeks her co-operation.

Are you worried at all? Your garners are filled, and you know you have enough for the winter. There never has been a day since the sun shone when the farmers of New England had such reason to thank God and take courage as in the closing days of this year 1893, because their labors have been followed by the blessing of God and a sure reward.

Carry this thought home. Let it echo and re-echo through these Berkshire Hills, up the valley of the Connecticut and on to the sea, that when man seeks by the highest use of his powers, by the exercise of his reason, by earnest, honest effort, to touch the mysteries which surround every movement of the farmer, whether with his flocks, his orchards, his fields, his dairy or his herds, lo! there comes forth a blessing to enrich and strengthen for still nobler effort.

The path that leads to a Loaf of Bread
  Winds through the Swamps of Toil,
And the path that leads to a Suit of Clothes
  Goes through a flowerless soil,
And the paths that lead to a Loaf of Bread
And a Suit of Clothes are hard to tread.

And the path that leads to a House of Your Own
  Climbs over the bouldered hills,
And the path that leads to a Bank Account
  Is swept by the blast that kills;
But the men who start in the paths to-day
In the Lazy Hills may go astray.

In the Lazy Hills are trees of shade
  By the dreamy Brooks of Sleep,
And the rollicking River of Pleasure laughs,
  And gambols down the steep;
But when the blasts of the Winter come,
The brooks and the river are frozen dumb.

Then woe to those in the Lazy Hills
  When the blasts of Winter moan,
Who strayed from the path to a Bank Account
  And the path to a House of Their Own;
These paths are hard in the Summer heat,
But in Winter they lead to a snug retreat.

(A horse was then brought into the hall and taken to the platform, and Dr. Twitchell proceeded to illustrate his method of judging a horse in accordance with the scale of points for judging horses established by the Massachusetts State Board of Agriculture for use at the fairs of the year 1893.)

Dr. Twitchell. In judging by the scale of points it is not necessary to have the whole class of horses before us, as we take one at a time, and measure it by itself. Whether you are judging a live animal or a ball of butter, it only needs, as I attempted to show in my talk, that we keep in mind our *standard of perfection*, which is what one would have each part or quality if he could reconstruct to suit his individual fancy. The benefit to the individual is that his ideal grows more definite all the while he is applying the scale. You cannot score a horse and go away and think about it without seeing where your standard of perfection has been strengthened. It may be somewhat a matter of intuition in the beginning, but practice makes clear and distinct the details. Nevertheless it is very simple. I cannot describe to you my standard of perfection, but I can use the card as an aid in illustrating what I would have, and there is the great benefit of the score-card. You remember what I said about scoring butter. A sample score has been sent me by the expert from the butter room. Perfection in flavor is 45, and this lot is scored 30, and the judge has marked, "Flavor injured by feed." In grain, perfection is 25; this is scored 21; "Butter worked at too low temperature." Color, 15, with a credit of 12, and marked, "Old cream" The salt is 10 points, and this is scored 8, and is marked, "Salt fishy." Package is 5 points for perfection, and this is marked 4, so that this sample scored 75 out of a possible 100 points, and the evidence is given in every part, showing why the judge has not placed a higher score. The exhibitor of this butter is thus enabled to understand just why his product was marked as it was, and if there has been any mistake the score-card enables him to call the attention of the judge to the error, something which cannot be done in the comparative system. The more that card is studied the more of an educator it will become.

Dr. Twitchell then called attention to the various structural points of the horse, explaining in what respect they came short of the standard indicated on the score-card. He stated that he preferred a straight face rather than a Roman nose, and being asked what the objection was to a Roman nose, said that while it is generally accepted as an indication of courage, it is not a good conformation, and that the Roman nose was as often to be found in horses wanting in intelligence as in those possessing extra courage. He liked a straight face, broad between the eyes, indicating brain power; fullness and expressiveness of the eye, telling of the intelligence of the animal and also his degree of education. The lips should not be thick nor thin, but well closed. Nostrils well rounded, full, large, open and not fleshy. Avoid a horse, he said, with a flabby under lip. I should not want a horse with too thin a lip. I should be afraid of a bad disposition. The Doctor was asked what color he would like the hoof to be, and said he liked a dark horn color; strong in substance.

Secretary SESSIONS. Would you cut a horse if the hoof was white, simply because it was white?

Dr. TWITCHELL. Yes, I would cut a white hoof always. Would expect it to be tender in quality, although it is not always so. A dark horn color is the ideal hoof. In regard to the color of a horse, chestnuts are coming to be fashion-able, and yet it seems to me that it is one of the passing fads.

The lecturer was asked if the color of a horse, other things being equal, indicated his power of endurance. He replied that he did not think, other things being equal, that there was anything in the color of a horse that would affect him. There is a demand to-day for chestnuts as against the darker colors, but the general market demand is for solid colors.

Mr. P. A. Russell (of Great Barrington). Doctor, what do you think of that old saying, " One white foot, buy it; two white feet, try it; and three white feet, deny it"?

Dr. Twitchell. Well, I think it is one of the old sayings. I do not think there is anything to it. I do not think it is indicative, on the one hand, of superior strength, of good qualities, or, on the other, necessarily of weakness.

No horse should be scored as perfect in any part, because perfection had not yet been reached in breeding, and the Doctor did not believe, therefore, that it should be indicated in scoring, because the moment it is fixed in the mind that an animal has reached perfection there is nothing more to be gained. One judge might score a horse 99 or 99½. Another would score the same horse 82. Both of them are just in their measurements, but they work from a different standpoint. One feels that perfection has practically been reached, and the other that there is room for improvement.

Right here we touch an important phase of the question. Because two men vary in their work some consider the system at fault, whereas the criticism has no weight. If a judge preserves his relative ratio of values throughout the class, he has administered justice to each exhibitor. Another may establish a different ratio, but not change the result in the least. Uniformity in ratio of cuts will come by education. What the exhibitor asks is that the work be honestly done at the time. This ratio cannot be established by any fixed rule; it must be left to individual interpretation, the protection of the exhibitor being the score-card and the blackboard, where the work of the expert becomes a matter for public criticism and inspection.

Being asked what caused a horse to overreach, the Doctor said: "I cannot tell you. It is partly a matter of education. Urging a colt beyond his natural powers will invite this and other evils, but bad or improper shoeing will do more. Sure we are that the intelligent smith can in the great majority of cases correct the evil by a proper fitting of the shoes."

Mr. P. A. Russell. Is stiffness of the dock an indication of power?

Dr. Twitchell. That idea prevails. I have never been able to bring myself to feel that it indicates as much as some buyers believe. It is to a certain extent an indicator, just as every other part is an indicator.

Being asked how many points a horse should score in order to be awarded a first premium, the Doctor said: "I would make 75 the limit for a first premium. I would not award a first premium to an animal that did not score 75 in structural parts, and for this reason, that if you put the seal of your approval as an agricultural society upon an animal scoring 50 or 60 points, you send the owner home with the idea that he has something nearly perfect and surely worthy of patronage. Wherever I go to award prizes I ask instructions from the officers before going into the field. If I were president of a society I would adopt the limit of 75. I would say that anything falling below that should receive a second premium, and if not coming up to a certain range, only a third; not to give the seal of the society's approval, a blue ribbon, unless there is merit sufficient to warrant it."

Mr. E. Hersey (of Hingham). Mr. Chairman, I wish to ask one question which seems to be directly in line with the matter which we have before us. If we are to judge by points, I would like to have the speaker explain to us how we are to know when we get a good judge of horses.

Dr. Twitchell. Take men in your own society who are not exhibitors, who are not interested in the competition, but who have an intuitive love for the horse. Here is one of the best lines of work upon which your agricultural societies can enter this winter, and that is, at your regular meetings, once a fortnight or once a month, bring in your poultry, bring in specimens of your dairy cows, and let some one gentleman score those animals as I have tried to score this horse, and the rest of you ask him questions and discuss the matter. You have men in your societies who can score just as well as any one else. All it wants is practice. Let the man first fix in his own mind just what he would have the animal to be if he could make it over, and then mark it accordingly as it approaches his ideal. It is a matter of education; it is a matter requiring a little time, but it is not a difficult matter for a man to do. I know down in our State we have poultry associations which meet once a month where they score in this manner. John Smith is announced to score a lot of Brahmas, and at the next meeting somebody else scores some other breed, and the result is they have developed a class of experts in judging poultry. The same thing can be done with horses, and with farm products generally, and in that way you have right among yourselves the men who will solve this problem. I do not believe that it is necessary or wise for you in your local societies to go to the expense of sending away for an expert to judge, but can take up the work among yourselves this winter during the coming months to your great advantage.

Question. I would like to know how high a score you have marked on a horse?

Dr. Twitchell. I do not remember that I ever scored a horse on structural parts above 82.

Mr. Hersey. You have not quite answered my point. What I want answered is, how am I to tell or how is our society to tell who are the experts in our society? I have no doubt we have them, but there is a question of who is an expert.

Dr. Twitchell. You have in your own agricultural society as good experts probably as you will find anywhere, and the use of a score card will aid greatly in enabling them to come to just results. Now, before I go further I want to answer the point raised by Mr. Hersey. It is got at in this way: Take a horse into your hall at your regular monthly meeting and let a half dozen of you, with these cards, go on and score the horse without any comment. Then sit down and compare your scores, and you will be surprised to find how near you come together in your work, and also how much such a comparison will help to strengthen your conception of the ideal.

Ex-Governor Hoard. It seems to me, Doctor, that question needs division; it is a little complicated. You are an advocate of a system which has much merit, but there is one difficulty, and that is, that you cannot, nor can anybody else, make an individual man over, and consequently to make the system practical there needs to be education.

Dr. Twitchell. That is the point I have been aiming at all the afternoon.

Ex-Governor Hoard. I agree with you, sir, that we do lack an intelligent system. If you have proposed one, I think you are a public benefactor; but after you have got the system, then you require men to carry it out.

Dr. Twitchell. Certainly, and the question is, how are you going to reach that result? There are men who have made this a study and are able to apply the system, but to bring them in to award the premiums involves expense. Shall we, then, confessing the utter failure of the old system to educate, continue its practice simply because the new way is attended with some difficulties? This knowledge we must have in order to discriminate in breeding. It is one of the essential factors in successful husbandry to-day, the only thing which can give power and stability. It is to be gained by such an object lesson as we have been having for the past hour, and again I say it may readily be acquired by practice work among yourselves. It was for this mutual helpfulness that your societies were created, for this they are sustained. There's not an agricultural society in Massachusetts but what, if the members will meet two evenings a month, bring together their fruit, vegetables and stock, supply themselves with the scales adopted by the Board, take up the work of judging, and then examine and criticise each other's scores, discussing the why and wherefore of each credit, will, before September, 1894, have within their own ranks men who can go out and apply this system with better results and greater satisfaction than was obtained at the exhibitions of 1893. Medium work done with the score-cards will satisfy better than any comparative work can, for the simple reason that the evidence is in writing, to be examined by every exhibitor.

Mr. P. A. Russell. I want to inquire if it is obligatory upon each society to judge horses by the scale of points as laid down by the State Board?

Secretary Sessions. There is such a rule of the Board. I will read it to you in a moment.

Mr. P. A. Russell. What I mean is, whether or not the agricultural society is obliged by law to adopt this system of judging horses?

Secretary Sessions. This is the action of the Board at the last annual meeting: "*Voted*, That in the judging of all live stock, fruit and vegetables, each society shall employ an expert, or experts, unless excused by the executive committee of the Board. These expert judges shall be instructed to appoint a time for listening to appeals, and to give their reasons for the decisions at which they have arrived, if called for; but their decisions shall be final." In reference to the scale of points the action of the Board was this: "*Voted*, That in awarding premiums, especially on live stock, vegetables and fruit, there shall be established by this Board a scale of points, which shall be adopted by all the societies, so that there shall be a uniform standard throughout the State." That is the rule of the Board of Agriculture as it stands at present. It is on the three hundred and fifty-second page of the last Annual Report of the State Board of Agriculture.

Question. Suppose that some society does not comply with that rule about the scale of points?

Secretary Sessions. I am not ready to state now, but when I come to make out my return perhaps some of you will find out.

Dr. Twitchell. I should like to emphasize that, for I consider it is the most advanced step taken by any Board of Agriculture in the country, a step which I believe is absolutely necessary, and I speak from observation and experience, from connection with agricultural societies for a long series of years. I have had a somewhat extended experience in passing upon stock by the use of the score-card throughout the Eastern States and in the Provinces. I believe that if you will adopt this system, and earnestly and faithfully, through the winter, take up the work of scoring and discussion, you will come up to your next exhibition prepared to do the work in and of yourselves very largely. Perhaps if you have a very large field of horses, or an exhibition of fine Jerseys, or some other special department, you will want to call in an expert, but in other cases you will be able to do it yourselves; and, judging from my experience, nothing you can do will so relieve your agricultural societies from all charge of bias and favoritism as the use of the score-card.

Question. In case they do not reach 75 points, is it intended that they shall be excluded from the first premium?

Dr. Twitchell. That is a matter for you to arrange for yourselves. Fix your own limit, and then if they cannot reach that, they should be excluded from the first premium. If they do not score that, I would mark them for second premium.

Mr. John E. Russell (of Leicester). I would like to ask whether there is no power vested in the judge to exclude an animal upon any one point?

Dr. Twitchell. On soundness?

Mr. John E. Russell. Yes, sir.

Dr. Twitchell. I should always exclude any animal that was unsound.

Mr. John E. Russell. Then the scale of points would not be used if there was anywhere a manifest unsoundness?

Dr. Twitchell. Yes. We commence on the score and run down until we find an unsound part, and then put there a cipher and stop. That score is returned to the owner. If I have made a mistake, he has the evidence on which to present his claim.

Mr. John E. Russell. For instance, if in judging a horse you noticed that he was subject to ophthalmia, you would stop there?

Dr. Twitchell. In case of blindness I would stop there and send the exhibitor notice, and give him the reason in every case. Gentlemen, a gross injustice is done exhibitors when you send them out of the field without any award and give them no reason for not giving them one. I thank you, Mr. Russell, for raising the point, because it is a good one.

The Chairman. Doctor, I would like to ask one question. In a trotting horse I prefer a straight hind leg. You cut this horse's leg somewhat. What would you have for a draught horse?

Dr. TWITCHELL. I should want a straighter and heavier leg for a draught horse than for a driver.

The CHAIRMAN. How much would you cut the horse for draught, if you were measuring from the draught standpoint?

Dr. TWITCHELL. I should want a straighter leg than we have for the trotter, because the horse is built upon a different plan all the way through. He is wider at the shoulders. He has a straight shoulder; he has a round belly. He has a shorter step, shorter pasterns and a straighter leg. It is not easy to describe the exact shape of the hind leg. If too straight, there is danger of trouble to the front part of the hock, and if crooked, to the back portion. In draught stock a blockier form throughout is called for, and as the motions are slower and the step shorter, the purpose being to lift and propel the heavy load, the line of the leg should not vary as much as with the driver. All the while we must carry with us the thought of form adapted to purpose. Fix types by breeding and selection. And, gentlemen, if you have a mare who has in her veins Percheron or Clydesdale blood, do not expect to breed trotters from her. We have got to get out of that method of breeding and go to work upon a single line.

I want to mention a little incident right here. A neighbor of mine has a fine Percheron mare. She trots in about two minutes and thirty-three seconds, and he has very triumphantly undertaken to traverse this very doctrine which we have heard here, — do not expect to breed from a cross-blood mare of that character. But it was noticeable that the standard-bred blood in that mare showed in her make-up more than the Percheron. He breeds trotters from her, and some family trotting horses, and he obtained a colt, and that colt cannot trot in five minutes. It is evident that the mare took her trotting qualities from her parentage on the trotting side, not the Percheron side.

The CHAIRMAN. Gentlemen, it is about time to adjourn. Secretary Sessions has a few words to say, if you will give your attention.

Secretary SESSIONS. As the secretary of the Board of Agriculture I have no power, and I cannot state just why the Board made these rules. But, as I understand it, the Board believes that an advance should be made in this system of judging. It is intimated here that none of the societies have done exactly what is required of them. Perfection cannot be expected in one year. I have no doubt that the Board will be lenient with societies which have honestly endeavored to come up to what is required of them. I hope every society has made an effort to comply with the directions of the Board. I should expect, if any have refused to make the effort, that they may be dealt with. I cannot say how that will be. That power is with the Board, not with me. This is an effort to advance the system by which the judging of all live stock, fruit and vegetables is done, and this may be perhaps enlarged in the future, or, if the Board thinks it made a mistake, it may go back. I cannot tell what the Board will do at the next annual meeting.

The meeting was then adjourned until 7.30 o'clock.

## EVENING SESSION.

The meeting was called to order at 7.45 by the chairman, who said: Gentlemen, the subject of the lecture this evening is The Horse. The lecturer is the Hon. John E. Russell of Leicester, whom I now have the pleasure of introducing to you.

# THE HORSE.

BY HON. JOHN E. RUSSELL OF LEICESTER.

When invited to lecture before the Board on "The Horse," I supposed that I would speak in the daytime and was prepared to discuss the questions relating to breeding and the care of young stock; but this great audience of ladies and gentlemen, gathered for an evening entertainment, leads me to change my design, and, if you please, I will speak on questions of interest to all who keep, use, or love horses.

My first lecture before the Board of Agriculture was at Waltham in 1877 on "The Breeding, Training and Management of Horses," and the discussion following it was perhaps more widely reported than any of the proceedings of our meetings. But neither then nor in my subsequent service on the Board did I ever advise the farmers to breed horses.

All farmers use horses; oxen are out of date, being unfitted for the implements with which we now carry on the work of the farm, and a considerable part of a farmer's capital must be invested in horses. It is important to keep them in health, to get effective service and to make them last to useful old age. It is an old English proverb that "Half a horse goes down his throat;" and there is another good proverb, "The breed is in the mouth." These sayings have a deep meaning. The first is a declaration that the animal, from the beginning of life, must be well fed; and the second tells us that breed and long pedigree are of no avail if the animal is not a good feeder.

The availability, endurance, condition and value, even of the soundest and naturally best of horses, depends upon the care he receives from his keeper. His failure, diseases and early decline may be directly traced to careless or ignorant management.

It is of great importance to save manure and make the most of it, and with this view many of our stables are built over cellars, which are reeking pits of it, upon which hogs are kept, and the steam and smell make the atmosphere in which the horse rests and sleeps unwholesome. Horses are worth more than manure and they should enjoy the pure air and good light of a well-ventilated stable.

Large box stalls are considered a luxury and advantage. I think this is a mistake. I would only use a box stall for a sick horse. Nor would I have the common standing stall too wide. Four feet or a few inches more is ample width. The exercise of a horse out of doors should be regular and constant, and it will not do to depend upon box stalls for it. Nor should horses stand upon litter or any kind of bedding. In a box stall they eat it and play with it. It should be removed every morning to a place where it can be thoroughly aired and dried. The floor of a stall should be level.

Hay racks which constrain the animal to feed with his head in the air are an abomination. Hay seed and dust continually irritate his eyes, which are organs of great delicacy in the horse. Hay should be put on the floor, so that the animal may feed in his natural position.

The diseases of man are largely due to gluttony. The greater part of mankind stuff themselves with food, are incapable of effective work, struggle with disease, and do not live half their days. This bad judgment in his own case the owner extends to his horse, and it is exceedingly rare to see one that indicates lack of nutrition. He may be old, lame or diseased, conditions his master cannot alter, but he has plenty of food.

Some horses fatten easily; they are strong, sound animals, of bilious temperament, that work without fretting and take life in a quiet way. Such horses are good feeders and need restraint. Others are nervous, take life hard, fret over their troubles, are slow, reluctant eaters and poor sleepers. Such need encouragement.

No rules can be laid down for feeding. The good stableman will understand his horses, observe them closely, and regulate the food by the work. The horse has the smallest stomach known to comparative anatomy. It does not hold more than half as much as he requires if, like his master, he hurriedly fills it three times a day with half-masticated food. When a horse is in pasture it is hard to find him asleep; he is eating nearly all the time. He has no gall bladder; the fluid, as fast as secreted, passes to its work, and digestion and assimilation go on with prodigious rapidity.

The German teamsters, in old times, fed their horses at short intervals with coarse rye bread, and it was a good practice.

I have said they are usually overfed. If I was to make a rule it would be to feed two per cent of a horse's weight per diem, unless he was engaged in hard work. Good hay should be half of his ration in weight, and the remainder oats. If these are crushed between rollers or bruised, they will be worth at least twenty per cent more than whole oats.

Salt in rock form should be where the horse can use it at his desire.

I would never turn him out to pasture unless he is thrown out of work for the whole season, but carrots in winter and cut grass in summer should be moderately used.

Indian corn, whole or in meal, is unfit for horses. It is heating and fattening. We do not want to fatten horses nor hired men.

Horses will drink a great deal of water if indulged in it. Like men, they are creatures of habit. It is good horsemanship to discourage them about drinking. The best time to give water is half an hour before or one and a half hours after eating. If watered just before eating, especially in cold weather, the temperature of the stomach is lowered beyond the digestive point. If he has what water he wants after eating, he washes the food out of the stomach into the intestines and much of its value is lost. The great loss of grain in the digestion of the horse is largely due to this action.

In the winter use of horses, clipping the hair is a wise practice. It is not long since it was bitterly opposed, and people were arrested in New York by Mr. Bergh's officers for clipping horses. But it is now common all over the country, and if the horses are carefully blanketed it adds to their comfort and health.

It is the fashion at present to dock carriage and saddle horses. We have gone back to the fashions of the early part of the century in ladies' dress and in trimming horses. I have never owned a docked horse. I prefer the full tail, though it is sometimes convenient to "bang" it. Many people think a long, full tail is useful to defend the horse from flies. That is not so. No horse can swing a long tail, even to defend his quarters. He can use a "banged" tail. The horse of the desert and the African barbs, "Sprung from the winds, and like the winds in speed," have grand, flowing tails of wavy hair. The wavy effect may be produced by braiding while in the stable. The Arabs carry the tail much better than other breeds. The reason is that their tails are well set on, and it is the custom to shear the hair from the dock of the colt. Horse breeders know that the foal carries his tail high and arched, but when the yearling has a full growth of hair, often matted with burs or heavy with rain or mud, the dock is pulled down by the weight and the arching is lost.

Coarse hair about the heels is natural, but I confess to a prejudice against it and have it clipped.

The hair growing in a thick tuft inside the ear must never be touched. Ignorance sometimes removes it with the scissors, but it is a defence against flies and other insects that would secure lodgment upon the sensitive skin inside the ear.

The long hairs which grow upon the muzzle are often plucked. These are not superfluous; they have a valuable use, having sensitive power like the whiskers of the cat.

It is the fashion to cut off the mane as well as the tail. Let us hope that the old fashion of cropping the ears will not be revived. The mane is of no use in the domesticated horse. In a state of nature it is coarse, stands up and falls on both sides of the neck. It is to defend the horse from the teeth of his enemy, which aims to seize him at the crest and drag him down. For thousands of years men have trained the mane to fall on the right side, but it still has to be coaxed. Virgil speaks of it as falling on the right side. The Greeks cropped the mane as we do in hacks and polo ponies. This is seen in the Elgin marbles and other ancient statuary. The best bred and thinnest skinned horses have very little mane; a heavy, coarse mane means a low-bred horse.

We measure a horse's height in "hands," a hand being four inches; the height is taken at the withers. Among the absurdities of our horsemanship is the custom of describing horses by weight. Advertisements of horses for sale rarely give the height, but invariably give a guess at the weight, as if that was a fixed condition. When a horse has reached maturity he is as high as he ever will be and will remain there, but he may weigh ten hundred under one master and eleven hundred under another, and be a better horse at the lighter weight.

Horses under fourteen hands are but ponies. Fifteen hands describes a small horse, but then inches begin to tell. Sixteen hands is a full, grand height for a horse, and when the animal is well-proportioned and has good action it is the best size for all uses.

Small horses are very useful for hilly roads and constant work, but they never bring a high price. A horse above sixteen hands is overgrown, though several great race horses have been sixteen hands two inches. Some horses are high at the withers; others are low and mule-like, with a high croup. In such cases ascertain the elevation of each part and take the mean of the two measurements.

There is an old proverb which says, "A good horse is never of a bad color." Horses are so varied in color, even in the same families, and display such excellence under any skin, that one cannot say with truth that one color is better than another. Like men, they are divided into nervous, bilious, sanguine and lymphatic temperaments, or into blended temperaments in which one characteristic predominates; but such a horse may be of any color. The Arabs vary through all shades. Gray, white and chestnut are the most prized color among the Bedouins, as indicating greater intelligence and higher courage.

Lady Anne Blunt, a great traveller in Asia and familiar with all the wandering tribes of the Euphrates, likes the bay Arabian best. She has seen a few blacks, but never one that she would choose. Piebald and spotted Arabians are only seen in the circus, never in Asia. The English and

American thoroughbreds, practically the same stock and descendants from the Arabs, incline to chestnuts and browns.

There have been some famous gray race horses. Imported Messenger was gray. The Lindsay and Winter Arabs were gray; also Medoc, Lightning, Blue Bonnet, and many more.

Blacks have been rare on the turf, though Imported Albion was a black, and some of his descendants had the color. Black is not a favorite color with grooms. It goes with coarse hair and skin; it fades in summer, and usually before moulting turns a dull foxy color.

The French family of Percherons, descended from the Arabs, rarely produces other than gray horses.

In the last century, when travel all over Europe was performed by means of posting, a team of gray or white horses was preferred, as being more cheerful and safer in the night. The traveller in the darkness could better see the post-boys on white horses. Consequently grays were only used for breeding, and the result is seen in the almost fixed color of the Percherons. Many people object to white feet and quote stupid old sayings about them, but the best horses that ever lived have had white feet and stockings.

I never use the check rein in driving single horses, but I am inclined to leave that to the judgment of each horseman. I have seen horses that seemed to require it and to travel better with it, but the great majority go easier and happier and look better without it. The argument against blinders is not a good one. They are not necessary on free, cheerful drivers, but many horses are lazy and some are both lazy and curious; such horses need blinders to keep them from watching the driver.

That it is not of great importance to know a horse's age is demonstrated by the fact that no one can tell a horse's age after he has passed eight years. If a horse is sound and has been well used the average stableman may not guess within half a dozen years of his true age when he is past fifteen. An eminent veterinary surgeon examined a pair of horses twice at an interval of four years. He was mistaken four years the first time. He forgot the horses, and at his second examination he was mistaken seven years. The greater part of our horses are broken down by bad management and ruined by shoeing when they are fifteen. The careful buyer sees the defects; the tremulous foreleg, the capped hock, the cocked pastern, the loose under lip, and bids accordingly. A horse of good constitution that has been well cared for may be eight years old until he has passed twenty. The usual guide to the age is the teeth, but some horses keep the teeth in good form longer than others.

In the days of slavery in Louisiana I have seen buyers at the great auctions carefully examining the teeth of the "hands" upon whom they meant to bid. Horses make such a short sojourn here and live in such a simple way that they do not lose their teeth as mankind do, but they change rapidly in appearance. When a horse is five years old his mouth is full; then all the world can tell his age. The grinding surface of the front teeth has a depression, or "cup," dark in color, which gradually wears away and disappears between eight and ten years of age; after that the careful horseman looks at the changing shape of the whole dental formation.

In early life the teeth are convex on the front surface and channelled at the back; the enamel is pure white and free from tartar. As age comes on they become more round in appearance; the gums recede and show the necks of the teeth. In youth they seemed largest at the base; in age at the crown. The tusks, which mares rarely attain, show prominently and slope backward. In youth the incisors stand perpendicular and meet each other full; as they wear and the gums recede the teeth incline outward, those in the lower jaw lean forward the most, and they assume the peculiar shape seen in old rats or other rodents. This appearance is a positive proof of old age.

The frequent statement that horses may live to great age under natural, healthy conditions is not borne out by observation or stud-book record. A horse, however kept, is old at twenty-five; after that his body and mind both fail.

In Blaine's veterinary work it is said that the first five years of a horse may be considered the equivalent to the first twenty in a man; a horse of ten years may be called as old as a man of forty, a horse of fifteen as a man of fifty, a horse of twenty as a man of sixty, a horse of twenty-five as a man of seventy, etc. Men live to be ninety and horses may live to be thirty-five; both are uncommon ages, and neither useful for labor.

I prefer old horses; they are more way-wise and more to be trusted. I have several in use; the youngest is fourteen, the next oldest is sixteen, the next nineteen, two are not less than twenty-five. The oldest two are not very useful; one of them is laid up part of the time with rheumatism, and I think both of them, and all the horses I have ever had, have not been generally useful after twenty-five. One of the best I have ever known was physically strong and able at thirty, but showed mental failure so as to be dangerous.

Mr. Wheeler. I would like to ask how the lecturer accounts for the change in the Percheron. If I understand him rightly, the Percheron is a descendant of the Arab.

Mr. Russell. I should have said that the Percheron is not a thoroughbred horse. The Percheron is believed to have had his origin and to have derived his qualities from the Arabs that were left in France from the Saracen invasion, but he has been bred for greater size and crossed with heavy horses brought from any part of Europe. Many of the dams of the Percheron horse probably have been heavy Flanders mares. The improvement of the Percheron horse has not been confined in later days to crossing with the Arab, or even the reinforcement of the blood from the Arab. They have used thoroughbred English horses at times, and also horses from other breeds, so it is a composite race.

Mr. Fenn (of Milford, Conn.). Mr. Chairman, I would like to ask Mr. Russell if the knife should be used upon the heels of the horse at all. I object to that. When the blacksmith shoes my horse I tell him to never put the knife to the heels of the horse.

Mr. Russell. You are very nearly right about that, because a horse's foot grows forward almost entirely. It grows at the toe. You may have seen horses that have been long in pasture; in a season their feet will grow so that they will turn up. I have seen wild horses in Central America on low lands whose feet have turned up during the wet season and curled over; often they get so disabled by the growth of their feet that they fall a prey to predatory animals. In a state of nature where the horse has choice of soil the foot wears down; he instinctively knows that he must keep his feet in proper shape. The blacksmith seldom understands how to cut the hoof properly. He rarely cuts the toe down enough; he leaves it too long, and then he puts from a quarter to half an inch of iron on, which causes trouble in nine out of ten horses you see on the road. If you tell a blacksmith that the foot is too long he will shorten it by rasping it around the toe. He ought not to do that. If he takes the hoof up before him and looks at the bottom of it, and begins to cut from the level of the heel, which ought to be about level with the frog, he may be able to shorten the toe of a horse from half an inch to an inch. That is the way to give the horse his proper bearing, because the heel and the frog should indicate the true level. Then the iron should be put on with a view to maintain it as nature has indicated. If there is a healthy frog — I won't say a withered one, all shrivelled up not larger than your thumb, but a healthy development of frog — the heel may be cut to the level of the frog.

QUESTION. What makes cribbing horses?

Mr. RUSSELL. That is something that no man has ever found out. It may be from indigestion or long idleness that a horse gets a morbid habit of swallowing wind. That is not done by mankind, except in political campaigns. I have known a horse to recover from it by being kept in a stall where he could not get hold of anything for the purpose of drawing himself together and getting into the position in which he sucks wind into his stomach. It is well to keep rock salt and lump chalk within their reach.

QUESTION. What makes horses weave?

Mr. RUSSELL. That is generally some affection of the brain, I think. When a horse weaves back and forth there is something wrong in his head. I have had one or two horses that did it and they went to the bad.

QUESTION. Do you think it is a good plan to have a window in front of a horse in the stall?

Mr. RUSSELL. Yes, it is well enough if you have it shut. You should not allow a draught of air to come through on him.

I would not have a hole for him to put his head through, because he would be very likely to get chilled when the wind blew, although I have seen horses allowed to stand in that way. I think it is very good to have a light stable, and not have a horse put in a dark corner. A horse should be where he can see other horses.

There is a good deal of breeding in this region. Some horse breeders are here. I wish to say to them that one of the greatest mistakes breeders make is to have a stallion stall and keep the horse in close confinement so that he scarcely ever sees other horses. A horse cannot be in good health, or a man either, in close confinement. Horses should be where they can have association and, you may say, the society of other horses; one reason why stallions become morose, crazy, dangerous creatures is because of close confinement. They do not have sufficient exercise and use and do not have the companionship of other horses.

Ex-Governor HOARD. I think, sir, you have made a very good point there. The naturally dangerous character of the male bovine is greatly aggravated when he is kept in confinement. I have known repeated instances of their being considerably modified by giving them the society of others. Their association with one another seems in some way to affect their disposition. I know of a dealer in bulls who allows them to associate, and he never had a cross bull in his life. They run together, young and old males. Society seems to have a peculiar effect upon these animals. I believe there is something in it.

Mr. RUSSELL. I know there is. A dear friend of every member of this Board and of the farmers of Massachusetts, the late Mr. E. F. Bowditch, had bulls that he harnessed and worked in carts, and considered their tempers greatly improved thereby. They need association and work, and so do stallions.

Mr. FENN. Have you any particular theory in regard to shoeing a horse for overreaching?

Mr. RUSSELL. No, I have not; but I will tell you what I would do. I would try the horse barefooted, and if he overreached, then I would trade him off. If he overreached unshod it would show that the shoeing was not the cause of it.

If he does not overreach barefooted it will show that the shoeing is the cause of it, and then the lightest shoeing you can have would naturally improve him.

Mr. James Cheesman (of Southborough). Have you had any experience in feeding dry brewers' grain as a possible substitute for hay and oats? A great many owners of thoroughbred stock in the New England States, and particularly in Massachusetts, Malcolm Forbes and Col. Henry S. Russell, have used that with very great success. Have you had any experience in that direction?

Mr. Russell. I have never used dried brewers' grain for feeding horses, but I am aware that it is a very valuable material for the purpose. It is highly recommended by gentlemen whose experience is greater than mine. If I were conveniently situated I should try it. Your suggestion will lead me to do so.

Ex-Governor Hoard. By every test that we can make, and by the reinforcement of a good deal of experience, clover should be a much more valuable food for a horse than timothy, and yet in the general judgment timothy is worth from two to three dollars more per ton than clover hay. I have a friend in Wisconsin who has been induced to try clover, and he finds that clover hay, pound for pound, produces a much stronger and more vigorous condition of the horses than timothy. I understand that some livery man in Boston, I cannot now say who, has made some experiment, and I would like to know if that has been brought to your notice at all.

Mr. Russell. I have tried it myself. I usually have a considerable part of my hay of clover. I have kept it separate, and have fed horses upon it. My experience is very favorable to it. I think that clover is fully as good as any other hay that we can give a horse. I have had the opinion in times past from trial that Kentucky bluegrass was the best grass for feeding horses, but the difficulties I have had with growing it and keeping it from tufting and getting a good crop from it alone, led me to use clover in with it, so that clover and bluegrass together have been the mainstay of my horses for years at a time. I think that clover hay is admirably adapted to horses and, in fact, to all stock.

Secretary Sessions. That is supposing it is cut and cured properly?

Mr. Russell. Well, you have got to have good luck in cutting it. If it does not turn out well I can feed it to sheep, for sheep will eat any hay that is damaged or not up to standard better than any other stock. The horse is not delicate about his fodder. He will eat oat straw with good effect, and wheat straw and very coarse hay. I do not think it is essential in feeding horses to have absolutely the best. The fact is, as we feed horses, Governor, as I have stated here to-night, we generally give them about twice as much as they ought to have anyhow, and they are largely wearing out their energies in feeding. I think there are very few men who make proper tests, for that reason, because they get horses into the habit of using a great deal more food than they can assimilate. The way to try a horse is to reduce his ration to the point where all of it is used in the natural economy. Then you can form a great deal better judgment, for we only feed horses for strength and to keep them in good form. It is an entirely different problem from that which is presented to the dairyman or the maker of beef. We do not want to increase the weight of the horse. We only want to keep him in good strength.

A horse sixteen hands high corresponds to a fine, well-grown, six-foot man. It is about the maximum of useful height. Neither the man nor the horse should be fat. If a horse measures sixteen hands, with proper-shaped withers, his weight is almost always too great for his size, and it comes from this constant practice of overfeeding, which wears him out in middle age, just as his master is worn out in the same way.

Ex-Governor Hoard. I want to confirm that idea. For two or three summers I have spent some time more or less upon cattle ranches, and I have been perfectly amazed at noticing the tremendous work that the cowboy's horse will do. A cowboy will start out, for instance, this morning at six o'clock, and he will keep that horse under the saddle until noon, and give him a short bite, may be three or four quarts of oats, or turn him out to grass, and in nine times out of ten he will work that horse all day, doing more work than any farmer in the State of Massachusetts dare to have his horse do in the way of expenditure of physical effort, and that horse is always ready to his call. The horses are never fed in that country anywhere near to the standard they are in Wisconsin. I do not know how it is in Massachusetts.

Mr. Russell. They are overfed everywhere except under the circumstances you describe.

Question. May I ask Mr. Russell if anything is to be done for the heaves?

Mr. Russell. I have not intended to answer any questions of this character, but as there is no prescription possible to be given in this case, although I think that better authorities are here, I will say there is no cure for the heaves.

The Chairman. Ladies and gentlemen, the hour has arrived when it is time to bring this meeting to a close. I feel it incumbent upon me to thank you for the close and quiet attention you have given. Hoping you will all come in to-morrow and give like attention, we will adjourn the meeting until half past nine o'clock in the morning.

## THIRD DAY.

The meeting was called to order at ten o'clock by the chairman, Hon. J. H. Rowley, who said: Ladies and gentlemen, the lectures of yesterday and the day before have been very interesting, the discussions able, and the matter has been presented in such a way that it may be utilized, and perhaps measured by a standard of dollars and cents. The lecture to-day is on a subject which cannot be measured by any such standard. I have the pleasure of introducing to you Prof. George F. Mills, of the Massachusetts Agricultural College at Amherst.

Professor Mills. Mr. Chairman and gentlemen of the Board, ladies and gentlemen, I thank you very much for your greeting, and presume it may possibly be owing to the fact that some of you know that I am a Berkshire boy, and everything that pertains to Berkshire County strikes a responsive chord in my heart. Although my home was for many years in the extreme northern part, still so far as Berkshire County is concerned I know no north, no south, no east, no west, for it is all "my own, my native land."

# EDUCATION FOR THE AGRICULTURAL AND OTHER INDUSTRIAL CLASSES.

BY PROF. GEORGE F. MILLS OF AMHERST.

The importance of education is admitted by all classes of our citizens, and at no time has it had more earnest attention from the people of Massachusetts than it has to-day. It needs to offer no apology, therefore, for its presence at this meeting. Though coming together to consider questions more closely connected with agriculture, we yet recognize the fact that its interests cannot be severed from any of those vital questions that affect the welfare of our agricultural and other industrial classes.

An eminent authority has said that "modern science has become fully aware of the importance of knowing every object in the light of its history. How it began and how it developed must lead to a knowledge of what it is." In the following paper it is proposed —

First. To review briefly the beginnings of education in Massachusetts.

Second. To present some considerations respecting education in general, with a glance at the more recent phases of its development.

Third. To show how the interests of our agricultural and other industrial classes are fostered by the Massachusetts Agricultural College and other educational institutions.

The general outline of the history of education in this Commonwealth is doubtless familiar to us all. The fathers laid the foundations and the children have built thereon. It is interesting to notice, however, what early provision was made for the founding of school and college. We find that "on the 13th of April, 1635, five years after the foundation of the city, the people of Boston, in town-meeting assembled, requested 'Brother Philemon Piermont to become schoolmaster for the teaching and nourteuring of children' in the town. In part pay thirty acres of land were voted him by the young colony. At about the same time, 'a garden plot was voted to Mr. Danyell Maude, schoolmaster,' also." Other towns made similar provision until, in the year 1642, in an attempt to make the privileges of the few towns general, the Colonial Court enjoined upon all towns the duty of providing these privileges in their several localities. By this act the duty of making education universal was enjoined.

In 1647 the Massachusetts Colony passed a law providing that every township of fifty householders should appoint a schoolmaster to teach the children to read and write; and it was further ordered that "where any town shall increase to the number of 100 families or householders they shall set up a grammar schoole, the Master thereof being able to instruct youth so farr as they may be fited for the University." This act made the support of public schools compulsory and education universal and free. By the year 1665, only forty-five years after the first landing at Plymouth, every town in Massachusetts had a common school, and, if it contained over a hundred families, a grammar school. In 1683 all towns of five hundred families were required to maintain two grammar schools and two writing schools.

In the autumn of the sixth year of the settlement of Boston, September, 1636, the General Court of the colony voted the sum of four hundred pounds "towards a school or college," and the following year twelve of the most trusted men of the whole colony, magistrates and ministers, of political foresight and abundant learning, were directed to execute the official order, — in the language of the ordinance, "to take order for a college at New Towne," the original name of Cambridge. This was the beginning of Harvard University. During the two hundred and fifty years that have elapsed since these foundations were thus laid the work has been continued and enlarged. The public school system has been established, private schools, academies and institutes have been founded, one and another has been added to the sisterhood of colleges, until to-day it is our pride and boast that, so far as the variety and excellence of educational advantages are concerned, few people are superior to those of the State of Massachusetts.

Of the one hundred and two persons who reached Plymouth on that first voyage of the "Mayflower" thirty-four were adult males. What had been their occupation in their Leyden home we do not know; but it is quite certain that the "prosperous labor and harvest" of that first summer and autumn at Plymouth show that then, at least, there was an "agricultural class" among them. In addition to the thirty-four males mentioned above there were, in that "Mayflower" company, "nineteen men-servants, sailors and craftsmen, who were hired for temporary service." Here we have our "other industrial classes." Of the men found in the numerous small settlements on the coast of Massachusetts and who were afterwards included in the Massachusetts Bay Colony, many were fishermen. But the self-same stern necessity that makes all classes of people, the high and the humble, the rich and the poor, dependent upon the tillers of the soil for the "bread that strengtheneth man's heart," and upon the blacksmith and carpenter and wheelwright for the utensils and conveniences necessary to even the simplest stages of civilized life, shows that among the people of this colony also there must have been found agricultural and other industrial classes.

What idea of education now was in the mind of these colonists? Let us read from the Massachusetts law of 1642, to which reference has already been made: —

> This court [so the record runs], taking into serious consideration the great neglect of many parents and masters in training up their children in learning and labor and other employments which may be profitable to the Commonwealth do hereby order and decree that, in every town, the chosen men appointed to manage the prudential affairs of the same shall henceforth stand charged with the care of the redress of this evil; so as they shall be sufficiently punished by fines, for the neglect thereof, upon presentment of grand jury, or other information of complaint in any court in this jurisdiction: and for this end, they or the greater number of them shall have power to take account, from time to time, of all parents

and masters and of their children, especially of their ability to read and understand the principles of religion and the capital laws of this country, and to impose fines upon such as shall refuse to render such account to them when they shall be required; and they shall have power, with the consent of any court, or the magistrate, to put forth apprentices, the children of such as they shall find not able and fit to employ and bring them up. They are also to provide that a sufficient quantity of materials, as hemp, flax, etc., may be raised in their several towns, and tools and implements provided for working out the same.

The selectmen of every town were further required "to have a vigilant eye over their brethren and neighbors to see that none of them shall suffer so much barbarism in any of their families as not to endeavor to teach, by themselves or others, their children and apprentices, so much learning as may enable them perfectly to read the English tongue and (obtain) a knowledge of the capital laws, upon penalty of twenty shillings for each neglect therein."

"If, after admonition, parents were still neglectful of their duty in these particulars" children might be taken from their parents, and servants from the custody of their masters, and be bound to such masters as the selectmen might deem worthy to supply the place of "the unnatural parent"— boys until the age of twenty-one and girls until that of eighteen.

Referring to the act and to the primitive Boston idea of barbarism, Mr. Horace Mann, for so many years secretary of the Board of Education, said in 1869, "Tried by this standard, many a man who now glories in the name and prerogatives of a republican citizen would, according to the better ideas of the Pilgrim Fathers, be known as the barbarian father of barbarian children."

"Training up their children in learning and labor and other employments which may be profitable to the Commonwealth." Mark the words: "training," implying direction, guidance, restraint; "in learning and labor," not learning alone; "and other employments which may be profitable to the Commonwealth," profitable not simply to the individual, but to the State; labor, not in the spirit of selfishness, but of patriotism, not for the good of one but for the good of all. In these simple yet comprehensive words do we not find the fundamental ideas of the public school, the technological school, the school of mechanic arts and the agricultural college, and all to be devoted, in loyalty of spirit, to the service of our beloved Commonwealth?

These fundamental ideas, with more or less prominence, characterized the education of our Colonial and Revolutionary periods, but within the present century they have received marked development. It has been said that while education is not more seriously regarded now than formerly, it is more wisely studied. What is education? What is its object? What are the best methods for securing its object? These questions and others of similar import are not new, and are being constantly repeated as the far-reaching importance of the subject itself engages the earnest thought of student and philosopher. Let us listen, for a moment, to some of the answers that have been given to these questions. Lord Bacon stated the object of education to be "the cultivation of a just and legitimate familiarity betwixt mind and things." Froebel says that education "is the harmonious development of the whole being." Pestalozzi declares it to be the generation of power. Emerson says that "the great object of education should be commensurate with the object of life." Herbert Spencer says, "How to live is the great thing that education has to teach," and still another says, "Education is, then, the development of all the powers of man to the culminating point of action — action in art, which is 'power or skill in the use of knowledge; the practical application of the rules or principles of science.'"

We see, then, that there is a broad distinction between education and the simple acquisition of knowledge. Education is a development, a growth, and the education of a man implies the development of all his powers. Hence we speak of physical education, the development of the body; of the education or development of one's mental faculties; of moral education or the development of one's moral nature. The simple knowledge of facts or of things has of itself comparatively little value. Of what value is it to know that the Declaration of American Independence was signed at Philadelphia on the 4th of July, 1776, if our knowledge be limited to that fact? Or of what use is it for a person to know that a potato is an esculent, farinaceous tuber, and not a root, if his knowledge is to stop there? To be sure, the acquisition of facts may call into exercise certain mental faculties, and the retention of these facts in the mind may call into exercise certain other faculties; but it is when we pass from a knowledge of facts to the apprehension of their relations, when we recognize the connection between cause and effect, when we compare and systematize and reach principles, that the work of mental development is most successfully accomplished. On the other hand, ignorance is not simply a lack of knowledge of facts, but also of facts in their relations. It is not because the thousands who are coming to our shores from foreign countries are wholly ignorant of facts that their coming is to be deprecated. Many of them know many things and have acquired skill in certain departments of effort; but it is because, while having this knowledge, they are so ignorant of the fundamental principles of our government and of the relations that, in a republic, one man sustains to another, — this it is that makes their presence here a menace to the perpetuity of our institutions. We see how it is that there is truth in the statement, "Knowledge is power." Knowledge may be a power for evil. Knowledge is a power for good when with the knowledge itself there is the spirit of goodness; but the simple acquisition of knowledge may not give a man this power. We see, moreover, that a walking encyclopædia is not necessarily an educated man, and that a so-called learned professor may have stopped so far short of a perception of the relation of his knowledge to the practical affairs of life as to merit the ridicule of his gardener. One of my colleagues said that he met a gentleman not long ago who told him that "college professors are not in it," to use a very common expression; "that they are away behind the rest of the world, because they know so many things, and yet some of them do not know anything." It is in this apprehension of relations and principles that that activity of mind is aroused which is the condition of development, and "teaching," — I make this statement here because of its importance, and because I know that there are some here whose interest in this great subject, like my own, is so strong that we feel we cannot too often learn what teaching is, — "teaching," in the language of an acknowledged master of the art, "is presenting the conditions which arouse certain conscious activities immediately needed for mental and moral growth."

A marked step in educational progress was taken when the high school was established. In 1826 every town containing five hundred families was required to maintain a town or high school which should differ from the old grammar school by omitting from its curriculum the Latin and Greek languages. Secretary Dickinson, in his last annual report to the Board of Education, says, "It is the peculiar work of the high schools to direct the learner in the acquisition of scientific knowledge and to the cultivation of the powers of generalization and reasoning." Important as is the work of the primary and grammar schools, we see that they are but preparatory to that higher grade of schools in which we look for the development and growth of the mental faculties. It is exceedingly unfortunate that any necessity should compel a parent to withdraw his child from the public school before the child has finished the high-school course. If thus withdrawn he loses an important part of the educational value of his course and may begin his life work without the mental training or discipline that the high-school course is designed to give.

The writer of one of the papers read at the recent centennial of Williams College, having characterized "the lack of a collegiate education on the part of so many students in our professional schools as a long-recognized and often-lamented evil," goes on to say that, "taking the country at large, it would appear that scarcely one-fifth of the young men who are preparing to become clergymen and lawyers and only about one-tenth of those who are looking forward to the medical profession have received a full academic training." In view of this fact the writer says, "If anything can be done to bring our colleges into more effective relation to the young men who are looking forward to professional careers, one of the greatest wastes and weaknesses of our education will be overcome." It is estimated that eighty-three per cent of our school population never, in their school life, go beyond the grammar school, and probably not more than two per cent go beyond the high school. If the lack of a collegiate education on the part of so many students in our professional schools be an evil so much to be deplored, what shall we say respecting the fact that so many boys and girls — eighty-three out of a hundred — attempt the work of life without having had the discipline and training of the high school?

It is, in part, with the hope that a larger number of pupils may be induced to remain in the high school until they complete its course that the latest important addition to the high-school curriculum has been made, viz., the introduction of the elements of manual training. I say in part; for, notwithstanding the strong pressure that has been brought to bear upon those who have in charge the direction of our public schools to eliminate studies that have been called theoretical and to substitute those considered more practical, yet the most intelligent advocates of manual training strongly repudiate any intention of specializing the work of the elementary schools in the direction of economic production. I quote from Mr. Macalister, superintendent of the Philadelphia public schools, and who, as many of us know, has been one of the strongest advocates of manual training: "The object of the public school is education in its broadest sense. If industrial or manual training cannot be shown to be education in this sense, it has no place in the public school. We have no more right to teach carpentry or blacksmithing than we have to teach law or medicine. The supreme end of education is the harmonious development of all the powers of a human being. Whatever ministers to this end is education; whatever interferes with its accomplishment, no matter how valuable in itself, belongs outside of the elementary school."

It is doubtless well known that in July, 1891, a State commission was appointed to investigate methods of manual training and industrial education. From a newspaper abstract of the report of this commission recently made for distribution we learn that the commissioners unite unanimously in the following among other recommendations: —

1. That the principles and practice of the kindergarten be taught in the normal schools.
2. That the principles and practice of manual training, so far as applicable in the primary and grammar schools, be taught in the normal schools.
3. That the principles and practice of domestic science be taught in the normal schools.
4. That high schools in which a course in the mechanic arts, approved by the Board of Education, shall be taught to boys, be established and maintained in all cities having a population of 20,000 or more.
5. That high schools in which a course of domestic science, including sewing and cooking, approved by the Board of Education, be established and maintained in all cities having a population of 20,000 or more.
6. That the Board of Education be by law required to appoint an agent whose special duty shall be to advise and aid in the introduction of manual training and industrial education into the public schools, and to visit and report upon all schools in which such training and education are carried on.

If these recommendations, and others made by the commission, be adopted and made law by the Legislature, it will be seen that a radical revolution in our present school system must be the result.

Whatever changes or innovations in methods of teaching or in courses of study be made, the public school must continue to be the only school for a large part of those who belong to the agricultural and other industrial classes. The fact that it is free from tuition charges and that pupils, while attending it, can live at their own homes and give assistance to those who need their help, will make it, in the future as in the past, the only available place for their education.

In dwelling thus upon the public school I do not intend by any means to lose sight of other very important educational influences. We must all agree, I think, that the newspaper is a very powerful agent in educating our young people. It is becoming more and more one of the great powers in the land, and I think that those who have the highest ideals of the profession of the journalist are coming to feel more and more that they have in their hands a responsibility which is very great. I have limited my thought to the schools because it is more in the line of that which I have to say particularly respecting other institutions.

All the more, then, should the public school give an education to those who attend it. It must give some measure, at least, of training to the body; it must educate the mental faculties; it must educate the moral nature. If it fail to teach its pupils how to think and how to express their thoughts; if it fail to assist them in the formation of habits of mental application or what is commonly called study; above all, if it fail "to countenance and inculcate the principles of humanity and general benevolence, public and private charity, industry, frugality, honesty and punctuality in their dealings; sincerity, good humor and all social affections and generous sentiments, among the people, then indeed shall it fail to accomplish the object for which it was established and to secure which the annual appropriations by the State are so generously made."

Should the education of our agricultural and other industrial classes go beyond the high school? Unhesitatingly we answer, "If possible, yes." There is little danger of over-education. The young men and women of the professional classes add to their high-school course four years of academic training before they begin their professional studies, and it is with these, their more fully equipped brothers, that our industrial classes must compete. The time has gone by, in this country at least, when education is to be regarded as the exclusive right of a favored few.

The motto of Harvard University, you know, is "*Christo et Ecclesia*," for Christ and the Church, because when the university was founded and in its early years it was felt that all those who attended the university were to be prepared for the ministry, and later on they were to be prepared for other professions. I have no statistics at hand, but I presume it will be found that in the first twenty-five years of the history of Harvard University, of Williams College, of Amherst College, and the leading colleges in New England a very large per cent of the graduates entered some one of the so-called learned professions. It is very different now, we know.

In the long race brains, and especially educated brains, will tell, and it has been well said that "the problem for every civilized nation to-day is how the largest amount of intellectual development can be given to its industrial population." I think we are apt to lose sight of that very important fact, — it is educational development as well as technical skill. It is upon the intelligence and integrity of our industrial classes that the safety and perpetuity of our institutions largely depend. We must have intelligent capital and intelligent labor before the conflict between labor and capital shall cease. In the battle of life every bayonet must be a thinking bayonet, and it is largely in our schools and colleges that the young soldiers must be equipped for duty.

After one has completed his high-school course, however, he may begin his preparation for some one industry, carrying forward his general education in connection with such preparation, and numerous institutes and technological schools have been established to meet these requirements of our industrial classes. One of the oldest of these is the Rennssalaer Polytechnic Institute, at Troy, N. Y., founded in 1824. The Massachusetts Institute of Technology, in our own State, is one of the leading institutions of its kind in this country. It is interesting to note the object which this institute has in view, as stated in its pamphlet prepared in connection with the Columbian Exposition: —

> While the applications of the sciences to the useful arts are extensively taught in the Institute of Technology, the primary purpose of the school is education. Not only are mere knacks and devices and technical methods constantly subordinated to the acquisition of principles, but those principles are studied with the predominant purpose to expand and develop the mind, to exercise the powers and to train the faculties of the pupil. What the institute aims to do is to graduate those who are, first, well-educated men in all which that term implies, and who, secondly, have studied the problems of some one technical profession, have mastered the scientific principles related thereto, and have had a certain amount of practice in the application of those principles to such problems.

Other institutions for the education of the industrial classes, monuments in these cases at least of the debt that labor owes to capital, are the Pratt Institute in Brooklyn and the Armour Institute in Chicago. I find this statement of the aim of the latter: —

> Its aim is to give young men and women, whether rich or poor, a liberal education, not outright, but with liberal provision of free scholarships to the deserving who need help and yet are resolutely anxious to help themselves; an education with the threefold purpose of acquiring knowledge, skill and culture. In other words, the training of the eye and the hand with the brain, an education which will develop into a relish for the higher forms of skilled labor, and will tend to infuse the class of workingmen with a more general and broader intelligence, and at the same time, by the practical application of art to industry, to develop that esthetic sense which our American artisans too much lack.

I trust I may be pardoned at this point if I make a suggestion. Those who have visited the Columbian Exposition during the last season, and those who have not, have marvelled at the beauty of the buildings that have been erected for that Exposition, and I think it has been a source of very great pride that among all the industries which found a home at Jackson Park no industry found one more appropriate, more beautiful, than the Agricultural Building. It was felt to be a worthy thing that that upon which so much depends should have had a worthy home there. And I hope the day is not far distant when at our Agricultural College the principles, at least, of architecture shall be taught. When nature does so much for the agriculturist why should not art do something for him also? If agriculture should have a beautiful home in that Exposition which has been and is to be a teacher of the world, why should not the farmers' homes, the farmers' houses and their buildings teach lessons of beauty? Why should not the farmer's boy be taught that it is no more expensive to build a barn which shall be in keeping with its surroundings, so far as its architectural structure is concerned, to say nothing of the economy which may be involved therein, than one which lacks such features? I think that those who have planned that structure which is going up at our Agricultural College, and in which all take such very deep interest, have thought, of course, of the necessities of the farm; they have thought of the matter of economy as well; but I believe that that building is to teach a lesson to the students who are there, and a lesson which is in this direction, that a thing which is made first of all perhaps for utility may also be made a thing of beauty, which is a joy forever.

In this connection I cannot refrain from referring to another institution founded in 1868 at Hampton, Va. It was designed to meet the wants of the "despised races" of our country, and to it have flocked the negro and, more recently, the Indian also. It has provided for the mental development of its pupils and for their moral training. It has a department of industries in which the following-named trades are taught: carpentry and wood-working, harness-making, shoe-making; the trade of the wheelwright, blacksmith and tinsmith; house-painting, printing, tailoring, steam engineering and gasfitting, and the rudiments of the machinist's trade. Agriculture, sewing and housework also are taught. Between six and seven hundred pupils have been annually receiving the benefits of a school founded and sustained by the tireless energy of that Christian hero and martyr who, in the flush of early manhood, leaving his Hawaiian home, graduating from our Berkshire College when the threatening storm of civil war had gathered, fighting bravely on many a field of that bitter conflict as an officer of United States colored troops, renewing, after the storm had passed, the consecration of his life to the service of God and of humanity, has, within a few months, been laid to rest, as he himself wished, "in the school graveyard, where one of the students would have been put had he died."

To the class of institutions established for the purpose of investigating and realizing the application of sciences to the arts belong the agricultural colleges founded under the Congressional Land Grant Act of 1862. Our interest naturally centres in the Massachusetts Agricultural College, with whose organization and history you are all more or less familiar.

It is quite unnecessary for me to give at this time a detailed statement of the work of the college, since this was fully set forth in a paper read last year at a meeting of this Board, by Professor Brooks, which paper was published in the secretary's report for 1892. I desire particularly at this time to call attention to that report, and to that article upon the work of the Agricultural College. It is sufficient to say that the college is holding strictly to the object so clearly stated in the act under which it was established, viz., "to teach such branches of learning as are related to agriculture, . . . in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life." During the last year changes, designed to raise the standard of attainment in the college and thus to increase its usefulness, have been made in the four-years course, while a two-years course and a graduate course have been added. There are now one hundred and sixty-two students enjoying the advantages that the college offers. Of these I find that but six are from Berkshire County. Do the citizens of Berkshire appreciate the opportunity which this college offers for the education of their sons?

There are two questions that may arise in the mind of one who wishes to give his son educational advantages in addition to those already enjoyed in the public school: First, "Why should I send my boy to the Agricultural College?" Second, "Can I afford to send him there?" This question, of course, I do not presume to answer; but there is in the minds of some an erroneous impression respecting the expense of a course at the Agricultural College. At the risk of repeating what is stated in the college catalogue, will you allow me to present a few facts?

Tuition at the college to students whose homes are within the State of Massachusetts is practically free. Room rent, board, fuel, laundry and military suit will amount to $200 the first year. The military suit, costing $15.75, will last through the course. A student who wishes to avail himself of the advantages of the labor fund can earn $50 during the year without encroaching upon the time necessary for study. Now, I put that sum very low. I say $50, without encroaching upon the time necessary for study, which practically means he can earn his $50 on Saturdays, when there are no college exercises. There are many students who earn twice that sum at the college, and, in fact, I should not be surprised if there are some alumni of the college in the audience here this morning who can tell a story of some of their own friends and classmates who have paid all their expenses at the college while there, and even have graduated from the college with more money in their pockets than they had when they entered.

One hundred and fifty dollars per year, then, is a liberal estimate for all necessary expenses. The interest on this sum for one year at six per cent is $9. Is it not worth while to ask yourself seriously whether any better investment for your son can be made?

"But why should I send my boy to the Agricultural College?" you ask. I answer, because —

First. Thereby the boy receives an education that is a development of his power and that will give him a better chance in the race. This education is obtained not alone from the instruction of the class-room and the study in preparation for it, important and valuable as these may be. He is educated by intercourse with his fellows. I would put that, of course, as of the first value and importance, and these are points which I think are very often overlooked, and which those of us who have to do with the students at college feel more and more are of great importance. He is educated by intercourse with his fellows, and what does that mean? The success in life of many a young man would tell, — the associations formed in college, the friendships formed in college, the attachment to that man who after the years had passed stood by his friend and helped him out of his trouble because he was his college friend, — that is the story of many a college graduate. His success, his ability to go forward in his work in life, has been wholly owing to the fact that he had a friend in college who was able to help him. He is educated by intercourse with his fellows, by the interest he will take in all matters affecting his life in the college, by writing for the college paper and other publications to which he will want you to subscribe; by the library to which he has free access and where he may bring his mind into contact with the great thoughts of great men; by the work of experiment and investigation carried on at two stations on the college grounds; by the clearer insight into nature's teachings that he will here receive as the mysteries of air and soil and plant are revealed to his delighted vision. Is not this an education greatly to be desired?

If your boy has a taste for agriculture and kindred pursuits, then you should send him to the Agricultural College because —

Second. He will thereby become a more intelligent and therefore a better farmer.

The word "farmer" is not found in the Bible. The idea is there, but it is "tiller of the soil" and "husbandman." That is a good word, for it implies thrift, prudence, economy. Not economy in the expenditure of money alone, but economy in the use of time and economy of strength as well. Who does not need to learn how to economize strength? and to the farmer or husbandman this lesson is especially valuable. There is a strength of vital force in himself and in his beast that he is too apt to squander, and there is a strength in the elements of air and soil and sunlight, in electricity and heat and chemical affinity, that too often is a lamentable waste. Many a farmer boasts of his success in reclaiming waste land who pays little heed to the waste of fertilizing power that is constantly taking place about him, and who, in his ignorance of the chemical composition of soils and of the adaptation of crops to them, is allowing upon every acre of his domain such a waste of possibility as would lead the scientist to exclaim, "All this is waste land."

We have been enjoying at the college some lectures from Sir Henry Gilbert, who is connected with the Rothamsted Station in England, which has been carrying on its work of experiment for fifty years, and this gentleman, seventy-six years of age, hale, hearty and strong, has been delivering at the college a course of lectures embodying the results of the experiments at this station. I have not been in a position to follow those lectures, and, in fact, I am not enough of a scientist to have appreciated them if I had, but I will tell you one lesson that has been impressed upon my mind as I have heard that man, to say nothing about the object lesson that he has been in teaching the students the value of patient, thorough investigation and experiment, showing how a man is willing to devote his life to the finding out of things which are going to be of value to his fellow-men. I say, entirely aside from all that, and the lesson has been to me a very impressive one, there has come this lesson running all through his lectures, — what a waste of power there is everywhere among our farmers; how little they know of the power that is in even the little corner of the garden which they think perhaps has no value in it! It is an impressive lesson, and a lesson which, it seems to me, will have very great influence upon the minds of those students who have heard those lectures.

At the Agricultural College the student may learn how to adapt means to ends. The means are here; the means are in the soil; the means are before him, if he only knows how to use them and adapt them to the ends which they are designed to meet. The student learns how to adapt means in the application of those sciences that are at the foundation of agriculture. This is what I mean when I say that he thus becomes a more intelligent and therefore a better farmer.

Now, I am going to ask you, ladies and gentlemen, to bear with me for a moment while I bring to you the testimony of one of the students of the college. Understand this I read to you was written by him as a part of the college exercises. It falls to my lot at the college to have charge of the essay work of the students, particularly of the senior and junior classes, and in the regular course of a college exercise this paper was handed to me. The student himself, of course, had no idea that I was going to use it in this way, and I do it for this reason. You and I were boys once, and we almost instinctively fall into the way of thinking, "Well, of course, the heads of the school want to put the best side out, and they want to make the showing just as good as possible, and perhaps if you could only talk with the boys, why, you would perhaps hear a different story."

Now, I want to say here that I believe that if there is in any institution in this country a thoroughly loyal body of students, that company is at the Massachusetts Agricultural College. They are loyal to the purpose for which the college stands, and they appreciate the privileges that they enjoy there. But here is what one of these students in the junior class wrote: —

> Here [that is, at the college] the science of agriculture, in its broadest and highest sense, finds not only a home, but also able expounders and defenders of its position and usefulness. Situated as it is, with every variety of soil, from lowland to upland, from marsh and meadow to rocky hillside, this college is perhaps better fitted for the study of the science of agriculture than any other agricultural college in the world.

As I was criticising these essays of the students, when I came to that sentence I was not able to say whether the student was right in that position. There are some here in this audience probably who can say whether the student was right in that statement. At any rate, I let it pass. I did not criticise it. I thought he was right when he said that "this college," the Massachusetts Agricultural College —

> Is perhaps better fitted for the study of the science of agriculture than any other agricultural college in the world. Here we find the farm raised to its proper position in the list of capital stock, and the farmer as much a business man as the merchant or lawyer. Here we find the old idea that "anybody can run a farm" a mistaken one, and that the successful management of a farm requires as much business ability, prudence, economy, judgment and practical knowledge of things as any other buying or selling business. Here the student sees the practical farm operations going on around him every day of his college course. His advantages in the study of agriculture are many and valuable. He hears the theoretical side brought out in the lecture-room. He sees the idea of the lecture-room brought into practice on the farm and at the barn. He finds at the Hatch Experiment Station experiments always in progress, proving theories, exploding mistaken notions and "old fogy" ideas, reaching out into the mysteries of life and decay, discovering new facts, revealing new truths, and doing humanity and the farmer a vast amount of good. Or he can go to work and learn by actual experience the use of machine tools, the methods of farming used and the results obtained. Then for his rainy days there is the college library always open and well stocked

with literature on this and kindred subjects. This feature of the college is an especially valuable one. Here he finds books on all the grades as well as on the thoroughbred varieties of cattle, by Johnston, Sturtevant and Curtis. Hundreds of books upon the sheep, the horse, and the other domestic animals, not to speak of the rare and beautiful volumes upon the moths and butterflies, are added every year. Then he finds the results of the various operations and experiments explained in condensed form in the monthly bulletins issued by the several departments and the yearly report of the trustees of the college, the whole forming a complete and exhaustive course in the main branch of the college.

There is the testimony of one of the students of the institution who is already beginning to have his eyes upon the advantages of the institution. He is one of those young men who have been led to get upon the heights somewhat. He has been led to have his vision extended beyond the narrow horizon of the little valley in which he has lived. I do not think that anybody knows the beauty of this Housatonic Valley unless he has climbed a mountain or some other hilltop from which he can survey the landscape o'er.

But, my Berkshire friend, as you think the matter over perhaps you conclude that your son is not far enough advanced in his studies to enter the four-years course at the college. Possibly, too, you do not forget that the expense for two years is one-half of that for four years, and you are quite sure that you cannot get on without the help of your boy for more than two years. Well, then, let him take the two-years course. It is designed for just such cases as this. The requirements for admission to it are less exacting than those of the four-years course. The instruction is more practical, less scientific; yet enough instruction in agriculture, botany, chemistry, horticulture, physiology and veterinary science is given to enable one to understand the bulletins that are being constantly issued from the experiment stations and to make practical application of the results of experiments.

I have met intelligent farmers, progressive farmers, men who want to keep up with the times, and they say they value these bulletins that come to them from time to time, but that there is a great deal in the bulletins which they do not understand; they do not know what these technical terms mean, and when the result of experiments is brought before them, they say, "I cannot avail myself of that, because I don't know about it." This I regard as an especially valuable point for these young men in the two-years course. We have there this year twenty, more or less, young men in the two-years course who have come there to take that short time for training, and who are to be taught to know these things in the way in which I indicate here, and they will obtain enough knowledge in those sciences to enable them to read those bulletins in an intelligent way.

Two hours each week are given to class-room work in such exercises as teach the correct use of good, plain English. If I had time I should like this morning to expand on that subject a little, for it is a matter of very great importance to these boys to be able to use their mother tongue. They are not the most proficient in its use when they come to us, and I am sorry to say not all are proficient in its use when they go from us; but we feel that much is dependent upon their ability to express themselves and give their thoughts to others, especially in this age. They cannot live by themselves; they cannot do business by themselves; they must mingle with men, and how are they to express their thoughts to men except through their English tongue? And, other things being equal, you will employ the young man who writes a page of correct, plain English rather than the young man whose English is so full of errors that you are ashamed of him and his teaching.

Book-keeping and mathematics are taught; practical suggestions as to roads and road construction are given. It is a thoroughly useful course and invites your earnest attention. Only remember that here, as elsewhere, the stronger one's mental grip the greater will be his acquisitions, and that this which has been said applies to all research and investigation also. If we wish to bring home the wealth of the Indies we must take the wealth of the Indies with us.

The Chairman. Any questions that you wish to ask the lecturer are in order.

Secretary Sessions. I wish, if there are any persons in the audience who have questions they want to ask about the Agricultural College in any respect, be it ever so small a matter, that they will be free to present them.

Mr. Pratt. Mr. President, I would like to ask the professor, if he has knowledge of this fact, what proportion of the graduates of the college make agricultural pursuits their life work?

Professor Mills. In answer to that question I will refer Mr. Pratt to the paper that was read by Professor Brooks last year. Professor Brooks is here in the room, and I presume he can answer that question more correctly than I can.

Prof. Wm. P. Brooks. Mr. Chairman and gentlemen, in reply to the question of Mr. Pratt, it gives me pleasure to say, because the matter is somewhat fresh in my mind, as I looked it up last year, that something over one-half of the graduates of the college are either working on the farm as farmers or engaged in pursuits which are directly connected with agriculture. Under such pursuits I class the work in experiment stations and teaching in agricultural colleges. Those two classes of work take a far greater proportion of the graduates than almost any other. I think there are no less than 17 per cent of the graduates of the Massachusetts Agricultural College who are employed in other agricultural colleges and experiment stations. This speaks volumes for the work of the agricultural college. I think I may say this without egotism, because I have not been connected with the institution as a teacher long, and I have not had much to do with preparing these men who are working as professors and teachers in agricultural colleges and as investigators at experiment stations; but those who have preceded me and many of those who are there now have been connected with this work, and I say that it is immensely to their credit that our graduates have been so largely in demand for this class of work. I am unable to tell you exactly how many of the different States of the Union employ graduates of the Massachusetts Agricultural College either in teaching at the agricultural colleges of such States or in their experiment stations, but the number is very large. Although we graduated our first class but little more than twenty years ago (1871 was the first graduating class), we have had several presidents of agricultural colleges, including Japan. There have been, I believe, six presidents of various agricultural colleges who have graduated from the Massachusetts Agricultural College, and there have been a number of professors of agriculture, professors of botany and horticulture, and professors of mathematics; and then, if you look at the experiment stations, we find that there too we are especially strong. The graduates of our college are all over this broad land, occupying responsible positions. I feel that the college serves agriculture as truly, and in one sense in a higher field, in fitting these men for these important classes of work, as it would by simply training them to go back upon the farm.

Now, I say that when, as the records prove, we turn out more than one-half of our men who are either on farms or directly connected with agriculture, it is a very creditable record, for it should be remembered in judging us in this respect, first, that by no means all of those who come to the college expect to become farmers They do not come there with that intention. They come from all the various walks of life; they come from cities and large manufacturing places. They come because they know we give a good, broad general training which fits a man splendidly for any pursuit in life.

And I may be pardoned for saying right here that the college gives one of the very best trainings for the medical profession. I should say as many as fifteen or twenty in all among our graduates have gone into various medical schools, a large number of them into Harvard, and they have taken a very high position in their classes, and have usually won the prize of positions either on the staff of the Massachusetts General or the Boston City Hospital. One of the most successful of these, a friend of mine, gave his most emphatic testimony to the effect that his training in the Massachusetts Agricultural College gave him a better preparation for the study of medicine than the training which could be obtained in any of the so-called classical colleges. He said that the graduates of Harvard College itself who studied with him in the medical school admitted that he was immensely better prepared for the study of medicine than they were, better prepared because of his insight into the sciences, his habit of close observation and attention which had been cultivated by his study and the nature of his training. I might give many other instances, had I time, of students who have had no intention whatever of becoming farmers; and we cannot be expected, of course, to graduate all farmers.

And further, I may say that no professional school succeeds in turning out all its graduates as men who take up the profession for which the school was especially designed.

Mr. Elbridge Cushman (of Lakeville). Mr. Chairman, I have been interested in the paper to which we have listened, and I was particularly pleased that the speaker presented that composition of one of the junior class giving his testimony to and his appreciation of the Agricultural College, and as we have heard from two professors from that college here this morning and one of the students, I arise at this time as a plain, common farmer of the Old Colony, living 150 miles from that college, to add my testimony and to tell what I know of the advantages of the Massachusetts Agricultural College to the farmers of the Old Bay State. When my friend from Plymouth County asked the question, from the best of motives, I know, how many of the graduates of that college become farmers and tillers of the soil, husbandmen, and the answer comes back, over fifty per cent, I wish to say to my fellow farmers of Massachusetts that I know from personal contact with tillers of the soil that were but half as many of the graduates of that college pursuing our calling every dollar that has been taken from the treasury of our Commonwealth would have been well expended. I wish to say to you, brother farmers, that in my intercourse with the farmers of Massachusetts, as I meet them at farmers' institutes and within the grange halls of our State, wherever I come in contact with a graduate of that college I find a man earnest in his calling; I find a man at the very head of his profession, a man who is looked up to; and I have never yet come in contact with a graduate of that college, in whatever profession he may have chosen for his life work, who is not an industrious, earnest man in his calling. I have the greatest faith in the future of that college, and if I had been blessed with a son I should have used my most earnest efforts to have him a graduate of the Massachusetts Agricultural College.

It has been the regret of my life that I could not have had the training that is given the boys at Amherst. I have rejoiced in the opportunity and the privilege of paying the bills of two daughters while getting a classical education at college. I believe in a college education, not only for our sons, but for our daughters, and I know from something of a personal knowledge of the Agricultural College and its work, and of the other colleges in the State, that the work done is as thorough and as efficient in every department as in any college that we have in the State of Massachusetts. So I want to say, brother farmers, do not raise any question, I beg of you, implying that the Agricultural College fails in its purpose because every boy who enjoys the advantages of that institution does not feel that he is called to make farming his life work. He may be better prepared through other tastes and instincts and love for other occupations to pursue other callings, but nothing that he will learn at the Agricultural College will ever come amiss to him, I assure you, whatever may be his choice.

Mr. T. S. Gold (secretary of the Connecticut Board of Agriculture). Mr. Chairman, being much interested in this subject, I have come to the conclusion to deny the truth of the inference that is drawn from the fact that all our boys who go to agricultural colleges do not go back upon the farm. The interests of agriculture are broader than the farms themselves. The whole community rejoices in the success of agriculture. Our daily supplies of food, our means of life, come from the success of agriculture in every employment and calling in life, and although these institutions are designed especially to help agriculture, it is a low appreciation of their value when you confine the result of their work to helping the agricultural classes. Let us understand how we rise or fall together as a body and as a State. The knowledge of the principles of agriculture on the part of our lawyers, clergymen, physicians, manufacturers, merchants and commercial men everywhere, and our gentlemen of leisure, if you please, is just as valuable to the

State, differing perhaps according to the degree of power and influence and position of the men in the various professions and callings. This knowledge comes to the benefit of all the citizens of the State, sometimes differing in degree, sometimes larger and wider, and sometimes not so great, whether they are engaged in these professions or callings or laboring on the farm. Let us throw aside that small prejudice that has been so often encouraged by the question, How many of your students go back to cultivating the farms?

Ex-Governor Hoard. Mr. Chairman, I am very much interested also. For the first time in the history of Wisconsin — we have agitated and agitated and agitated until we have produced a state of public sentiment. As I say, for the first time in its history the college of agriculture in our State University contains more students to-day than the college of law, and we think that the water now is beginning to run in the right direction. We have been very lax. The agricultural population of this country suffers to-day in comparison with other classes in more ways than one. They suffer for recognition as among the forces of society, and there is nothing to-day that will bring about that recognition so emphatically as the promotion of a broader degree of intelligence among those classes. Stand among the lawyers and the doctors, the politicians and men of force and influence in society to-day in Massachusetts, and do you not believe that the agricultural property of this State would find itself in a more just relation to all the other property of the State if it was represented in your councils with a larger degree of force and intellectual ability? Do you not think that the taxes that agriculture has to pay in proportion to what personal property has to pay in Massachusetts would be adjusted more fairly if agriculture was intellectually the peer of every other profession in the State of Massachusetts? Why, gentlemen, agriculture is suffering everywhere for a lack of the broader cultivation of the intellect. The hands of our farmers are hard enough, God knows, but the heads have not been hardened yet as much as they ought to have been, and there is no way of hardening the head except by using it as you do the hand, that is, by work, and thus you are doing the highest service to the whole State. In Wisconsin to-day there is more property that escapes taxation than pays it. A very nice state of affairs, is it not? Every dollar the farmer owns stands out there and gets a square shot from the assessor, and he hits the bull's eye, too. There are men in my own town who are worth $100,000 who are paying taxes on $500, $1,500 and $2,500. That is their total assessment. It is so all over this whole country, and how is this condition to be remedied except by the promotion of a broader degree of intelligence?

Now, I have one suggestion to make, and I hope to see somebody set the matter going. I want to do something on this question of unequal taxation, and if it is in order I will make this suggestion. Publicity is the great corrective of evil in the United States, for the moment you make a thing clearly public, that very moment you reduce the percentage of evil. The very moment you throw any infected district open to the sunlight and the air, that very moment you reduce the percentage of infection, and when you have any evil existing, if you can only get it before the public, that very moment public opinion corrects that which law cannot. I would suggest that you as an agricultural organization, in the interest of fair taxation throughout the State, should begin to agitate this proposition, that immediately after the assessment of taxes has been made by the assessors it be published; that the personal property assessment of every town be printed and set before the gaze of everybody to determine the fairness and accuracy of it.

The CHAIRMAN. A man may appeal to the assessors to equalize or reduce his taxes, and if he is dissatisfied with their decision, he may appeal to the county commissioners.

Ex-Governor HOARD. How many of the farmers in this town of Great Barrington ever inspect the assessment list after it is made?

The CHAIRMAN. Well, not one, I think.

Ex-Governor HOARD. If it was published they would be led to inspect it.

Secretary SESSIONS. Mr. Chairman, another thought has occurred to me while the last two gentlemen have been speaking. They have expressed the idea which I had in my mind a great deal better than I could say it, and I am very glad indeed that they have so presented it; but here is one other phase of this question in Massachusetts. You all know the agricultural class is in a vast minority. Out of two and a quarter million people, probably not over one hundred thousand are connected with agriculture directly. We, being in this minority, are unable to compel the redress of our grievances. It is quite different from what it is in the agricultural States, so called. We need the help of others. The Agricultural College has been criticised because of the few graduates who return to the farm, but I have yet to meet a single graduate of that college who is not an educated and powerful ally of the agricultural class in Massachusetts, not only in this matter of taxation, but in all matters pertaining to the interests of agriculture. If you find a merchant in the city of Boston, as there are some, who is a graduate of the Agricultural College, you find there a powerful friend of agriculture, an advocate of justice to the agricultural classes and to their interests. If you find a preacher who has been educated at that college, you find there an intelligent advocate and defender of the agricultural interests of the State. So of the doctors, so of the lawyers. Therefore I say we are blessed by the influence of every graduate of that college, and shall be as long as time shall last.

Mr. ETHAN BROOKS (of West Springfield). There is one subject in connection with education at the Agricultural College which has not been touched upon, and that is military discipline, and I should like to hear something about that.

Professor MILLS. That was referred to by Professor Brooks in the article which he read last year.

Mr. ETHAN BROOKS. The point is that it is worth a great deal to the individual student, and may be at any time of great advantage to the country, to have young men fitted so that in an emergency they can take positions as commissioned officers in the United States Army. It is a sort of junior West Point in the matter of military training.

Professor BROOKS. I do not think, if my memory serves me, that I treated of that at any length in the printed report of the work of the Agricultural College, although I referred to it; but I do not think I need to look at the report to speak upon it, because I have been through it myself and I know what it is. I know what effect it has upon the students themselves. You all know probably that it is compulsory, that we must have it whether we will or not. But even if it were not compulsory, those who know the benefit of it would have it. Of that I am thoroughly assured, for my intercourse with the students of that college as a student, and later as a teacher, thoroughly convinces me that it benefits them in many ways. The physical training is of great importance. I wish that some of you could be present with me in the college chapel on two occasions of the year. The first occasion would be about the first of September. I would ask you to go to morning prayer with me when the college year opens, and I would direct your attention particularly to the freshman class as they come in. The second occasion when I would ask you to go with me to the college chapel would be on the day of our commencement exercises, when a class graduates, and I would direct your attention to the senior class as they come in. If you were not thoroughly convinced that the military training of the college was an advantage to the young men, then I should be greatly mistaken.

The points suggested by Mr. Brooks are certainly also of great importance. Should it ever happen, which God forbid, that war were suddenly forced upon us, certainly the graduates of the agricultural colleges — for they all go through the same training — would constitute a most important nucleus of an army. They would furnish officers who would be able to enlist and drill and organize men, and would give this country an enormous advantage at the start. The great disadvantage in our last war was that we had not men who were fitted to drill and train and organize their men, so that from these two points of view the effect upon the men physically and the importance from the military standpoint, I should say that the military training of the college is wholly justified. I would not see it given up for anything.

And as I speak these words another fact occurs to me. The mental training, too, is of great importance, for the young men as they advance in the course are made officers. They take command of the lower classes. If you should visit our campus during the drill hour you would see the men divided up into squads and companies, not under command of a paid teacher, but under command of their fellow-students of the upper classes, and this training gives men confidence in themselves, the ability to command and manage others, which is of almost priceless value.

Secretary SESSIONS. It strikes me that Governor Hoard remembers, just as I remember in my own experience, something like this. After being in the service some time and being at grand review, I was under the command of an officer, a brave man, an educated man in every respect except that of military science, and wanting to wheel his company, he could not remember the term to use, so he said, "Haw around here, boys. You know what I mean."

Ex-Governor HOARD. Not only that, Mr. Secretary, but the lack of that knowledge which the professor has mentioned resulted in terrible consequences to the lives of the men, not only in the army of the North but also in that of the South. It cost an enormous outlay and waste of life to get right, to get into a condition of effectiveness and discipline in the mobilization of the forces on either side. And what was lacking? Simply military intelligence. I remember that it cost my regiment, the Fourth Wisconsin, one of the earliest sent out, months of time and a large amount of consequent sickness and death before our officers had intelligence enough to know how to care for the lives of their men.

Professor BROOKS. One other thought occurs to me that I want to present right here. We shall not have to wait until we have another war to appreciate the value of these graduates of agricultural colleges. They are making themselves felt to-day wherever they are, in numerous instances as officers of the militia, so that the influence of the college is radiating out in all directions even to-day, and the effect of this military training is more marked than was previously anticipated.

Professor MILLS. I was talking with a father last evening whose son was at the Agricultural College, but was obliged to leave after one year, and the father said to me, referring to this very thing, "The advantage which my boy received from his military training while he was at the college I would not have had him lose for anything." He was unfortunate in that he was not able to stand erect. His legs were bowed. The father said, "In some way the military drill at the Agricultural College took that thing all out of him, so that when he came home at the end of the year he was able to stand erect."

The CHAIRMAN. I would like to ask Professor Brooks if there are not large numbers who leave college well fitted for land surveying.

Professor BROOKS. In answer to the question I may say that there are a very considerable number that engage in the pursuits mentioned, and naturally they are inclined towards those branches of business which have a relation to rural affairs, drainage, sewerage, the utilization of sewage through irrigation, road building and road improvement and various kindred subjects. These are subjects which very naturally engage the attention of men who have an appreciation of agriculture in its manifold relations, and among the graduates of our very first class we number one who is to-day one of the most prominent, if not the most prominent, of any engineer in the city of Boston who is connected with work of that kind. He has planned and executed numerous important works for various public institutions and for towns and cities, works providing for the agricultural utilization of sewage and drainage. The engineering profession ought to receive much greater attention than it does, so that those of our number who become engineers may truly serve the cause of agriculture in manifold ways.

I want to say just a word more, what has been hinted at in what Governor Hoard and some others have said better perhaps than I can say it; but I want to be a little more explicit, because I would like to direct attention to the importance of this subject, and that is, the possible and probable influence, as our graduates increase in number, upon the public schools of the State. I thoroughly believe that thus far the tendency of the training given in the public schools which the farmers have supported has been to educate away from the farm, to give a smattering of this or that, but that they are entirely apart from this relation to the practical affairs of farm life, giving a distaste for farm life; and I believe that while, of course, there are other agencies at work, this is one important reason for the great and ever-increasing rush towards cities and large towns and desertion of the farms. Our graduates, whatever profession they take up, whether they are, as Secretary Sessions so eloquently said, doctors or lawyers or ministers or business men or manufacturers, I believe one and all have a thorough sympathy with farmers, and I look to them to exercise an important influence in changing the system of education in our public schools with a view to lessening this tendency to leave the farms. When once farming is thoroughly understood in reference to its great value, every intelligent mind can but respect it and admire it.

It has been my fortune and privilege for the last two years to have for a considerable part of the time as a private student a gentleman some fifty years of age, a gentleman of independent means, but who owns property that he would like to know better how to manage, and I mention him for this special reason. He has again and again, as I took up one topic after the other and talked it over with him, said, "Why, I never dreamed of this. I hadn't the slightest conception of it." That is the common expression of everybody who has never looked into these things. Some people have no respect for farming and farmers, or but very little, simply because they do not know what farming is. Now, our graduates in all walks of life, knowing what it is, whether they are farmers or not, will, I am sure, exercise a most important influence in changing the system of training in our common schools.

Adjourned until 1.30 P.M.

## AFTERNOON SESSION.

The chairman called the meeting to order at about 2 o'clock and said: We have for the subject of the lecture this afternoon one that we are all directly interested in, whether we are farmers or not, and the lecturer will be Mr. E. W. Wood of West Newton, who will speak to us on fruit growing, and whom I have the pleasure now of introducing.

Mr. Wood. Mr. Chairman, ladies and gentlemen: The subject selected for this afternoon's discussion is the broad one of fruit growing; so broad that to cover it even imperfectly would be impossible in the short time which can be given to it at this meeting. We shall have to adopt the method of the man spoken of yesterday, who ploughed the field with his wife's steers and let them run wild because the whole field needed ploughing. The subject may be very properly divided into two distinct and different parts, fruit growing for market, or orcharding and field growing, which is one branch, and garden culture, another. But I felt that for this meeting, a farmers' meeting, it might be more appropriate in the short time I am to occupy to make some suggestions in the line of orchard and field growing mainly, and to that branch of the subject I will invite your attention for a short time.

# FRUIT GROWING.

BY E. W. WOOD OF WEST NEWTON.

Fruit has never received from the farmers in the New England States care and attention in proportion to its value, compared with other crops, either for domestic use or as a market product.

In the earlier years, when the first object with the farmer was to produce as far as possible everything required for domestic use, the fruits were mostly what are termed wild or natural fruits, and among a scattered population were sufficiently abundant without care or cultivation to supply the limited demand. There were no means of turning to profitable account any surplus except in the case of apples, which were used much more than at the present time for making cider and vinegar. The introduction of new and improved varieties and the concentration of population in manufacturing villages and cities created a demand for fruit, and both the improvement in quality and the demand have continued to increase to the present time. The improvement in cultivation has not kept pace with the improvement in quality or the increased demand. With most farmers the tree fruits are an incidental crop, grown upon land from which some other principal crop is annually taken.

The members of the Board early recognized the importance of fruit cultivation on the farm. In 1861 they appointed a committee "to prepare a catalogue of fruits adapted to the Commonwealth of Massachusetts." In their report the following year they say: —

> Fruit culture has become an important appendage to the farm, and although the temperature and soils of New England have not been considered so propitious as some other portions of our country, yet it is believed by your committee that with judicious cultivation

there are few if any of our States where success is more certain or the results more profitable than in Massachusetts. The consumption of fruit has become so common as to constitute it one of the most important articles of daily food. The loss of a crop is now deemed as a great calamity; its abundance as one of the choicest blessings, adding largely to the social health and comfort and to the commerce and wealth of the country. It is wise, therefore, for this Board to take under its special cognizance this department of husbandry and to offer every encouragement for the further development of this interesting branch of industry.

The tree fruits which may be profitably grown in Massachusetts are the apple, pear, peach, plum, cherry and quince, mentioned in the order of their importance or relative value. The apple is the most valuable fruit grown. It enters more largely into consumption as an article of food than any of the fruits. It is admirably adapted to our soil and location. We are situated near the centre of the best apple belt known. The northern portion of the Middle States, New England and portions of the Provinces produce the best apples known to commerce. This fruit improves in quality as we pass from warmer to colder climate up to the limit where it can be successfully grown. The apple quickly responds to care and cultivation, but a large portion of the fruit in our markets shows the effects of neglect in cultivation and care in picking, assorting and preparing for market. The apple is constantly becoming more exclusively a farm product, as the space required for growing the trees prevents their being set on estates of limited area. Many of the best orchards in the State have been wholly or partially destroyed in the smaller cities and larger villages to make room for building improvements.

The land best calculated for an apple orchard is not the most desirable for ordinary farm purposes. The ideal location for an apple orchard is a hill sloping in any direction rather than the level plain, the advantages being that the trees are more open to the light and air, giving better color and flavor to the fruit and better natural drainage.

Formerly an abundant crop was not desirable, as the supply so far exceeded the demand as to leave little profit for the portion that was sold; but within the last twenty years there has been a constantly increasing demand for export to foreign countries, which has taken the surplus fruit, often at better prices than were realized in the home market. The amount of fruit exported varies widely in different years, not because there is not a foreign demand, but in unfruitful years the crop is insufficient to supply the home trade. From 1870 to 1875, the first five years when this trade became generally known, there were shipped from this country to foreign ports 451,379 barrels of apples, returning in value $1,510,984; during the last five years, from 1888 to 1893, there were shipped 2,959,432 barrels, returning in value $8,744,465, and this trade is still in its infancy and susceptible of almost indefinite extension.

In connection with the export trade in green fruit there has been a constantly increasing demand for apples for evaporation. It is reported in Bradstreet's report that within the area of a circle forty miles in diameter around the city of Rochester, in New York State, there have been in a single year more than six million bushels of apples evaporated. The importance of this industry has hardly yet been recognized in Massachusetts. There were exported, during the five years from 1870 to 1875, 13,348,746 pounds of evaporated fruit, returning a value of $716,894; for the five years from 1888 to 1893 the amount was 87,782,433 pounds, returning $4,750,141.

Of the evaporated fruit shipped during the last five years, 62,300,000 pounds were shipped from New York and only 607,000 pounds from Boston. Among the advantages of exporting evaporated fruit is the reduced cost for freight, being about one-sixth the cost of the same value of green fruit, and the ability to hold it when it arrives at its destined port to take advantage of the market. This disposition of the fruit enables the grower to utilize what otherwise would prove a waste product, as the windfalls and bruised fruit, with comparatively little labor, may be made to yield from sixty to seventy-five cents per bushel, which, if carried to the cider mill, would average little if any more than ten cents per bushel.

In setting an orchard to grow apples for the wholesale market the selection of varieties is a matter of the first importance. A few well-known varieties will prove more profitable than a miscellaneous assortment, having only a local name and reputation. A few years since an effort was made to ascertain the proportion of the different varieties of apples exported, and from the best information obtainable it was found that between eight and nine tenths of all the apples shipped to foreign ports were Baldwins.

If there is a home trade to be supplied, it may be desirable to set trees enough to supply the demand for any desirable local varieties, but beyond that the Gravenstein, Hubbardston, Rhode Island Greening, Baldwin and Roxbury Russet would furnish all the varieties necessary for an orchard, however extensive, and of these the Baldwin should be by far the leading variety. It is a native of the State; makes a strong, vigorous growth; adapts itself readily to different locations and soils; is a profuse bearer; the fruit sells readily in the market, commands a good price and keeps in good condition longer than any of the others except the Roxbury Russet.

The apple under ordinary conditions is a biennial fruit. The bearing year for most orchards in this State is the even calendar year, though to a less extent than formerly, as a change has been effected in some cases by late frosts in spring and in others by the canker worms. The bearing year may be changed if the blossoms are removed from the young trees for three or four years when they would naturally produce their fruit.

The principal enemies of the apple are the codling moth, canker worm, tent caterpillar and apple maggot. Fruit-growers are largely indebted to the experiment stations for the discovery of means for destroying the insect pests and the fungoid growths injurious to fruit trees. Experience has shown that by the application of arsenical poisons for the former and copper solutions for the latter, in accordance with directions as to time and methods of application given in bulletins issued from the various stations, there has been a marked improvement in the quality and appearance of the different fruits.

In the cultivation of the pear Massachusetts has always held a leading position. In no part of the country is this fruit more successfully grown. At the biennial meetings of the American Pomological Society, having a representation from every State in the Union and the British Provinces and held in all parts of the country, Massachusetts has always taken an exceptionally creditable position wherever it has made an exhibit of its pear fruit. The pear under favorable conditions will prove more profitable for the first fifteen or twenty years than the apple, as the trees come earlier into bearing and are more reliable for an annual crop. The surplus of this fruit is sold in Philadelphia, New York, Maine and Canada, and with the improved methods of transportation there is no reason why the late varieties of this fruit should not become an article of export as well as our apples, if grown in sufficient quantities to meet such demand.

There are two kinds of pear trees sold from the nurseries in about equal proportions, and if planted in a deep, strong, moist, but well-drained soil and given good cultivation both will prove satisfactory; but if planted in a light soil, with gravel subsoil, the standards, or the pear budded on the pear stock, with its longer roots foraging over wider space, with good care, will produce fairly good results; but the dwarfs or the pear budded on the quince stock will invariably fail, and the discouraged grower declares pear growing unprofitable and the nurseryman from whom he bought his trees a fraud. That it requires unusual care on the part of nurserymen to secure accuracy in what they sell and their advice to patrons is true; but that failure more frequently rests with the grower rather than the seller of trees is equally true. The dwarf tree is indispensable in growing this fruit. It is especially necessary in gardens with limited space. Some of the desirable varieties can be successfully grown only on the quince stock, and its early bearing makes it desirable in starting new orchards, as it will produce fruit in three or four years from time of planting. Some of the stronger growing varieties, if planted as they should be, with the quince portion of the stock below the surface of the soil, will throw out roots from the pear stock, becoming standard trees; but they usually throw one or two long roots, making an unevenly balanced tree. When it is desirable to get the early bearing of the dwarf and afterward to change the tree to a standard it may be easily done by a process called lipping, which consists in removing the soil around the trunk to the depth of two or three inches, when it will be found that the pear stock has overgrown the quince portion, forming a callous. By puncturing this with a narrow gouge or pocket knife, raising narrow lips of the bark, and pressing the soil between the lips of bark and the wood in six or eight places equidistant around the trunk, returning the soil around the tree and covering with a light mulch, roots will strike out from the incisions made and an even-balanced standard tree will be secured, with roots more evenly distributed than on a nursery-grown tree.

The grower for market, as in the apple, will find more profit and less difficulty in disposing of his crop by confining himself to a limited number of varieties. The Bartlett, Sheldon, Seckel, Bosc, Angouleme, Dana's Hovey, Clairgeau and Anjou, the first and last grown in larger proportion than the others, would furnish as desirable a list as could be selected for our markets at the present time. For the amateur a longer list would be desirable, covering the entire season when the fruit can be had in good condition for the table. The following list, with ordinary care, would furnish the table with the most desirable varieties from the middle of July to the following March, named in the order of their ripening. Summer Doyenne, Giffard, Clapp's Favorite, Bartlett, Seckel, Sheldon, Bosc, Comice, Angouleme, Dana's Hovey, Anjou and Vicar. The improved cold-storage houses have proved a great benefit to the pear-growers, as the October pears may be kept in good condition for the Thanksgiving, Christmas and New Year's trade, and at any time when there is an oversupply of the earlier varieties a portion is placed in cold storage, thus relieving the market and sustaining prices. There have been put in cold storage in Boston twenty-two thousand bushels the present season.

The pear is perfectly hardy in our climate and longer lived than any other of the tree fruits. There are several trees in the suburbs and around Boston more than two hundred years old, still bearing fruit, and the famous Endicott tree, in Danvers, planted by Governor Endicott in 1630, still continues to produce its annual crop of fruit. The pear has few insect enemies and seldom suffers severely in either fruit or tree. A disease called pear blight has made its appearance occasionally and in some sections of the State, causing serious damage to the trees, though it has been slight in New England compared with its effects farther south and west, where large orchards have been totally destroyed in a single season. It makes its appearance usually during June and July, and is seen by the leaves turning black. Sometimes it is confined to a single limb or branch, at others several limbs are affected at once, showing the whole tree is diseased. In the former case generally the tree may be saved by cutting off the diseased portion down to sound wood, but in the latter the tree should be removed at once from the orchard.

The peach of late years has become one of the most unreliable of our tree fruits. Some of the older members of this Board will remember when the peach was grown in almost every garden and when this most delicious of all the New England fruits was so abundant that large quantities went to waste. Various reasons have been assigned for the failure of the peach, none of which have proved entirely satisfactory or suggested a remedy which has restored the tree to its former vigor or fruitfulness. The suggestions of worn-out soil, change of climate or extreme cold do not solve the question, as the trees have been grown on virgin soil with no better success. The weather records show but slight variation in climate, and while some have gone so far as to declare they could tell the exact degree of cold that would destroy the blossom buds of the peach, facts show that in 1884 the buds were almost entirely killed throughout this State the week before Christmas, although the mercury had not dropped to zero, and reports from Michigan show that peach trees exposed to a winter temperature of twenty-eight degrees below zero came out in good condition in the spring and bore an abundant crop of fruit.

Formerly peaches were grown almost entirely on seedling stocks, planting the pits from the best specimens. Later the nurserymen secured some superior varieties among these seedlings and budding them on seedling stocks, introduced them to the trade, and for many years the growers have been confined mainly to the following varieties: Coolidge's Favorite, Early and Late Crawford, Old Mixon and Stump the World. Experience has shown that continued reproduction by budding, grafting or cuttings tends to weaken the constitution of plants and trees, and for more than forty years these varieties have been reproduced by budding. In the mean time the disease called the yellows has attacked the trees, increasing the difficulty of growing healthy stock, as there is the constant liability of selecting pits and buds from diseased trees. The disease is not easily detected in its earlier stages, the first indication usually being the growth of small wiry shoots from the trunk and larger limbs of the trees, though not unfrequently the premature ripening of the fruit is the first symptom of its presence. The disease is supposed to be contagious, and the diseased trees, as soon as discovered, should be removed from the orchard and burned. The peach tree is so easily and quickly grown and the fruit so desirable that a strong effort should be made to restore it to its former vigor and fruitfulness, and the most direct means would seem to be growing seedling trees from healthy stock. Notwithstanding the discouragements in growing this fruit, some growers, by perseverance and constantly renewing their orchards, have made it the most profitable fruit they have grown.

The plum is a desirable fruit for the table, and, when it can be successfully grown, profitable for market. The tree is perfectly hardy, makes a quick growth and comes early into bearing. The grower of this fruit will meet with two obstacles to success: First, the curculio, a small insect that deposits its eggs beneath the skin of the fruit. The young larva, when hatched, causes the fruit to fall from the tree. The insect is easily dislodged from the tree and falls directly to the ground, and if fowls are allowed to run in the orchard and the trees are occasionally jarred by striking the limbs with a padded mallet, the fruit will not receive serious injury. But a more difficult matter is with the black knot, a fungoid growth which spreads rapidly among the trees when once it gets a lodgment. If neglected the trees are soon destroyed. The practice in combating this disease has been to cut the warts off as they appeared; but this affords only temporary relief. It disfigures the trees and they soon become an eyesore and of little value for fruit. A more successful method practiced by some growers has been to go over the trees carefully every spring, painting over the young warts, as they appear and may be seen by the discoloration and slight swelling of the bark, with kerosene mixed with some pigment (ordinary whiting answers the purpose) so that it will not run down the limb. This prevents the growth of the wart and illustrates the saying that "prevention is better than cure." Experiments are being made with encouraging prospects of success to prevent this abnormal growth by spraying the trees. If some simple and effective means be discovered for overcoming this enemy the plum will become one of the most desirable fruits for both garden and orchard. There have recently been introduced several varieties of Japanese plums of excellent quality and desirable for general cultivation. The Bradshaw, Lombard, Imperial Gage, McLaughlin, Jefferson, Washington, Green Gage and Coe's Golden Drop are among the most desirable of the old varieties. The first two are especially desirable for market.

There are few trees more ornamental than the cherry, especially the heart-shaped varieties. They make an upright growth, pyramidal in form, and with their dark, glossy foliage present an attractive appearance planted judiciously near the farm buildings. They do not require as much care as the other tree fruits. They make a quick, strong growth, and if forced are liable to injury during the winter. The Black Eagle, Black Tartarian, Coe's Transparent, Downer's Late and Hyde's Seedling are the most desirable varieties.

The quince has been the most neglected of the tree fruits, but within the last few years there has been an increased interest shown in its cultivation. It has been grown in such limited quantities that its value has not been appreciated. It is the most desirable of all the fruits for preserves, sauces, syrups and jellies, either alone or with other fruits, to which it imparts its peculiarly aromatic flavor. It is of easy cultivation, but thrives best in a deep, rich, moist soil. The Orange quince is an old variety and more generally grown than any other, but the Rea and Champion, more recent introductions, are preferred by some growers.

The profitable growing of the small fruits depends more upon location than the tree fruits. They are gathered in the warmest season of the year, are tender and more liable to injury in transportation. They require more care in their cultivation, but they are more immediate in their returns, and may be grown successfully and profitably in connection with the larger fruits.

The strawberry is the most extensively cultivated of any of the small fruits. It requires deep, rich, moist soil, highly fertilized, and clean culture, for the best results. The growers having adopted substantially the same methods for growing this fruit — that is, in matted beds — there is not so much chance for improvement in growing as in picking and preparing it for market. There is no work done on the farm that pays better for the employment of adult skilled labor than picking and preparing strawberries for market. The results of the practice of different growers is seen in the Boston market every day during the strawberry season. It is the practice of many growers in the outlying towns to employ children to pick this fruit. They pick through the heat of the day, pulling the fruit from the vines when soft, often breaking the flesh, causing it to bleed, and the fruit is sent at night to market to be sold the next day in competition with the fruit from the best growers near the city, who employ experienced adult help and pick the fruit between 4 and 9 o'clock in the morning and 4 and 8 o'clock in the evening, nipping off the fruit by the stems, hardly touching it with the hand, and placing it carefully in the basket. The morning's picking is sent immediately to market, and so delicate and sensitive is this fruit that the morning's picking will bring more in the market than that picked in the evening and kept as carefully and cool as possible over night. The fruit thus carefully picked and prepared for market has averaged the growers twenty-five cents per basket, while the fruit from the outlying towns has sold from eight to twelve cents per basket. A near market is desirable, but not indispensable to success, in growing the strawberry. This fruit varies so much in different soils that it is impossible to give definite recommendations as to the varieties. The following are recommended for general cultivation: Belmont, Bubach, Charles Downing, Jessie, Leader, Miner's Prolific and Sharpless.

The currant is a much neglected fruit, though it is a profitable market fruit and may be grown successfully in the orchard among the apple and pear trees longer than any other crop. The Versaillaise and Fay's are the best red varieties, and Dana's Transparent and the French Transparent the best white.

The raspberry and blackberry, although grown in some towns to a larger extent than any other fruit for market, are more liable to injury during the winter than other fruits, as none of the best varieties are perfectly hardy.

We are situated on almost the northern limit where the grape can be grown in open culture, yet the increase in the amount of this fruit grown for market has been as large if not larger than any of the small fruits within the last twenty years, and the most of this increase has been in the northern part of the State, as the largest vineyards are to be found in Concord, Fitchburg and Ashby, and extending up to and across the line into New Hampshire. The introduction of new and earlier varieties and the girdling of a portion of the vines, as practiced by some of the growers, has made the crop more secure from early frosts. The Moore's Early, Worden and Concord are the varieties generally grown for market.

To the farmer interested in this subject the natural inquiries are, what are the opportunities and what are the possibilities for fruit growing in Massachusetts? As to the opportunities, it may be said: First, we have a soil and climate not excelled by any State in the Union for producing some of the best and most largely consumed fruits grown; second, we have thousands of acres of land, at present of little value, admirably calculated to grow the orchard fruits; third, the means of cheap and rapid transportation from every part of the State to the wholesale markets and the port for shipment; fourth, we are nearer the foreign market than any other State having equal shipping facilities.

The possibilities are: First, converting land of little value into the most productive portion of the farm in proportion to the expense for cultivation, and at the same time making a permanent addition to the value of the farm; second, by the cultivation of the tree and small fruits in combination they may be made a source of income every month in the year; third, with the constantly increasing demand and the rapid growth of the foreign trade in both green and dried fruit, as shown within the last few years, there would seem to be no reason why, with more care in the cultivation of fruit, it should not become one of the most profitable products of the farm.

Many hesitate to set out an orchard because the returns are not so immediate as with annual crops; but the land among the trees in a young orchard may be used for growing the ordinary crops and all the small fruits. Nothing adds more to the appearance or creates a more pleasing impression upon the stranger or the purchaser of a farm than a thrifty, well-kept orchard. I doubt if upon any of the so-called abandoned farms advertised by our Secretary there could be found a well-cared-for, productive orchard of any considerable dimensions. Such farms are not abandoned. If from any change of circumstances a change of ownership becomes necessary they readily find purchasers.

Aside from the advantages of fruit as an article of commerce, nothing produced on the farm conduces more to the health and enjoyment of the family than a liberal supply of the various fruits in their season.

Charles Downing, who was a life-long co-laborer with our own Colonel Wilder in their efforts to improve the quality and extend the variety of our fruits, says: —

> Fine fruit is the flower of commodities. It is the most perfect union of the useful and the beautiful that the earth knows. Trees full of soft foliage, blossoms fresh with spring beauty, and finally fruit, rich, bloom-dusted, melting and luscious — such are the treasures of the orchard and the garden, temptingly offered to every landholder in this bright and sunny though temperate climate.

The Chairman. Gentlemen, I hope you will avail yourselves of the short time that remains to ask any questions of the lecturer that you may wish.

Secretary SESSIONS. Give us specific questions, gentlemen. I think Mr. Wood can answer them.

Mr. A. PRATT (of North Middleborough). I think Mr. Wood has well placed the apple as the most important fruit. Now, I wish he would go further and tell the best way to prepare the land and the best method of cultivating and fertilizing crops among the apple trees until they become of sufficient size for bearing purposes.

Mr. WOOD. As for preparing land, any land that will produce a good crop of corn will be good apple land, and in setting out trees I would set them at least thirty feet apart; thirty-five feet is better, especially the Baldwin. It is a spreading tree. While the trees are making their growth any of the root crops and all the small fruits may be grown among the trees, and any fertilizer adapted to the crops grown. After the trees commence bearing and other crops are discontinued an occasional dressing of fertilizer containing a large proportion of potash, if the ground is kept under cultivation and free from weeds and grass, will be found sufficient. I would get three-year-old trees, and when they start to grow do not allow too many branches from the main trunk. That is one serious fault in starting a new orchard. A man has an orchard set out and he is inclined to let them throw out too many limbs and in a few years he will have to remove more or less, and cutting a limb from a tree is like cutting a limb from a man. It weakens the tree, makes a wound and it takes a long time to get entirely over it. If you will start with four branches as nearly equidistant apart around the trunk as possible, you will have all the top in ordinary trees that you will want.

Secretary SESSIONS. You do not mean equidistant around the trunk, but up and down the trunk?

Mr. WOOD. No. They will start out very near together. It is desirable to get them as near together as possible.

Mr. PRATT. I wish you would go a little further. I am more particularly interested in the form of cultivation. What fertilizer would you use to fertilize the orchard?

Mr. WOOD. I would have stable manure, if I could get it, until the trees commence bearing. When they come to bearing fruit you want a fertilizer which makes the fruit, and then give them potash manure. But in cultivating an orchard, either the pear or the apple, more particularly the apple, you can grow all the ordinary crops. It is considered that root crops are better in an orchard than cereals, but you can grow any of them.

Mr. PRATT. As I understood you, you recommend a hillside, and for two reasons. Have you any preference which side, south, east, north or west?

Mr. WOOD. I do not think it makes any special difference, the advantages being better exposure of the fruit to the sun and air and better drainage.

The CHAIRMAN. What causes the difference in color of the fruit? In the eastern part of Massachusetts it is green; in the majority of cases here in this part of the State it is red. What is the cause of the difference in color, and is it preventable?

Mr. WOOD. Well, I should not expect to see any difference if they had an equally good location for sun and air. I do not think our growers would be willing to say our Baldwins are green in the eastern part of the State.

The CHAIRMAN. When I was there I saw some. We claim to have a good many red Baldwins out here.

Mr. PRATT. Red apples will always sell better than any other in the market.

Mr. WOOD. Yes, sir.

Mr. STETSON. I would like to ask Mr. Wood how old a tree must be before he would abandon grafting, providing it was a vigorous, healthy tree?

Mr. WOOD. Any "healthy, vigorous tree," if the fruit is not desirable, may be safely and profitably grafted; but if the tree is of considerable size it is better to take two or three years to make the change, beginning at the top and set one-third the number of scions necessary to change the whole tree the first year.

QUESTION. Do you think there is anything to force the growth on these hills?

Mr. WOOD. I do not know but it can be done, but I know that it is not very often done. I do not think there is any advantage in doing it, and there is where the trouble comes with almost all our fruit-growers. They do not make apples a specialty; they do not make the crop a special crop. As I stated in the paper, they grow some other crop on the ground as the principal crop, and then they take what apples they can get. To give a good illustration, I will say that I attended an institute meeting in Mr. Cruickshanks' neighborhood in 1888. That was one of the most abundant years for apples in Massachusetts, and the apple was the subject for discussion, and after I had spoken half a dozen men were on their feet at once. They said, "You have told us how to grow the apples. Will you be kind enough to tell us how to sell them? We have our cellars full, and we cannot sell them for enough to pay for packing, barrelling and marketing." Dr. Fisher was in the audience, and I said, "I have been talking an hour, and there is a man here who has had experience and can answer that question better than I can," and asked the Doctor to respond to that inquiry. The Doctor was a very modest man. He said, "I do not know as I am prepared to do it. I have not sold my fruit. I usually sell it the first or second week in February. I have about two hundred barrels of winter fruit which I propose to sell. We hear a good deal about the price being very low, but I shall be disappointed if I do not get a fair price for my fruit, for I have been growing it here now for thirty-four years. I have never had occasion to complain of the price I got for my fruit, and I never had better fruit than I have this year. I have been over and thinned my fruit." Some of the farmers smiled, and he said, "I notice some of the farmers smiling at thinning apples, but I have always done it, and I have always found it to pay. It does not make much difference whether you pick them in June or October. You will pick them in October if you do not pick them in June. If you pick off one-half in June, what you leave for October will be worth picking." Well, some time after that, — I knew the parties that were selling the Doctor's fruit, and I stepped in and asked them what they were paying for apples. One of the proprietors said, "Well, we are paying from seventy-five cents to $1 a barrel for what we get. The apples are very poor." He knocked the heads out of two or three barrels and showed me their condition. I told him of Dr. Fisher's confidence that he should get a fair price for his apples notwithstanding the unfavorable condition of the market. He said he would agree to give the Doctor $2.50 for his apples without seeing them. Now, that showed what reputation is worth. The next summer the Doctor invited a committee up to his place to see his vineyard, and as we were going up I said, "Doctor, you remember that little talk about selling apples last winter? I would like to ask you — and I don't ask out of curiosity, but for a more definite purpose — what you got for your apples last year?" "Well," said he, "I grow, as you know, but three kinds of winter apples, Hubbardstons, Baldwins and Greenings, and," he said, "I sent my Greenings to New York and got $3.25 a barrel, and my Hubbardstons and Baldwins to Boston, and got $3." That illustrates better than all the talk I can give you the matter of growing and marketing apples intelligently.

QUESTION. Does the Doctor practice spraying his trees as well as thinning the fruit?

Mr. WOOD. I think he does now.

Mr. GEORGE CRUICKSHANKS (of Fitchburg). Allusion has been made to Dr. Fisher. Being a neighbor of his, I avail myself of his knowledge. He is very willing to give an opinion. He loves to have any one go to him and ask him any question regarding his methods of fruit growing, as my friend, Mr. Wood, can well testify. He sprays and thins his fruit every year. He does not use his force pumps. He takes a common syringe. He exhibited that, the Board will remember, in Boston.

Secretary SESSIONS. Two years ago. Any one who chooses to look at the report will find the discussion of the syringe he used and the manufacturer's name.

Mr. CRUICKSHANKS. It cost $5. It holds a pint of water, and he can throw it twenty feet. We recently went over his pear orchard together. His pears are largely Bartletts, and there happened to be a few trees outside of the regular orchard lines, and for some reason they were overlooked. When his man was picking the fruit he noticed that the pears were not so good on these few trees. They were not so fair; they were not so large; they were inferior to the rest of the orchard. It did not occur to the man at the time, but when they came to look it up they found they were not sprayed.

Now for the result. Four out of five of the orchard were No. 1 fruit; four out of five of those that were not sprayed were No. 2, — just the reverse. The Doctor says it would not have cost twenty-five cents in time and material to have sprayed these few trees that produced fruit in that way.

With regard to thinning, he says a great many people laugh at him about that, but he is satisfied that it is much easier to thin the fruit at that time. He says some talk about the trees being so large that it will take a long while to do it, but he says a tree that will produce four barrels of apples, if it is a very large tree, will take a man nearly half a day sometimes to thin it. He says it does not cost so much to pick the fruit at that time that is to be thrown away as it does to pick it in October and then throw it away. Then there is a double advantage. He gets the nutriment of the whole tree into this amount of fruit that is of value, and gets rid of that which is of no use.

The apple may well be called the king of Massachusetts fruits, yet how sadly it is neglected. You see our orchards as you ride along the railroad, past these farms, not necessarily abandoned farms, — the trees all gone to wrack and ruin from sheer neglect. If you want a lamp to burn and give you light, you must feed it with oil, and you must trim it. Just as surely you must feed and trim your fruit trees if you expect profitable returns. In reference to these trees, in the first place, the planter, whoever he might be, thinks if he digs a post-hole and puts the roots into the ground that he is then going to get a profitable orchard by waiting a little while. We all know what the result is. It goes too far without pruning. Then he goes at it with a vengeance and makes another mistake by taking out too much. On my place, where I have lived a number of years, I found just such an orchard, where the trees were in such condition that you could not see the stumps of the trees, to say nothing about getting near them. I have got most of them now so I can see them and get near to them, but it has been almost murder, it seemed to me, to do as I had to do in order to accomplish that; but I was going to have a good tree or I was not going to have any. I was surprised after cultivating the ground and giving the lamp some of this oil to feed on which it required, or, in other words, giving the land fertilizers or good stable manure, barnyard manure, — I was surprised to see how they recuperated, how they came along up. I was very careful, mind you. It took me several years to do that; but I was very careful about taking off too much. I think some one mentioned that here, about being careful and not take off too much.

Mr. Pratt. Mr. Cruickshanks, won't you tell us when you think is just the right time for spraying, just the right growth for the commencement?

Mr. Cruickshanks. I take the Doctor as my authority on spraying, and he is as reliable as any man you can find. I have not practised it enough. Speaking from memory, the Doctor says he has no fungus. He burns off everything that can hold a fungus. He burns the rubbish, burns the grass. He says there are fungus spores in that grass, and it is liable to get on your trees. He begins in some cases before the buds expand at all. In that case he uses a stronger solution. Then immediately after the blossoms fill and the fruit is set is the time to spray for the codling moth. His mixture is very different from what is recommended, one ounce of sulphate of copper to 100 gallons of water, and I forget how many pounds of lime in the mixture to 22 gallons of water. He has figured it down so that he has learned that even that amount in some cases will injure the foliage. I cannot tell you the particulars of that.

Mr. Pratt. Does that answer for the different sprayings at different times?

Mr. Cruickshanks. That answers for the fungus. That is all he takes off.

Secretary Sessions. What does he use in spraying for the codling moth?

Mr. Cruickshanks. He uses Paris green.

Secretary Sessions. And when is that?

Mr. Cruickshanks. When the blossoms fall. You perhaps have all noticed the apple tree when it blossoms. The blossoms stand up in the calyx where the codling moth deposits its egg. Spraying must be done before the apple gets large enough to turn over, — one teaspoonful to three gallons of water; one even teaspoonful of Paris green in three gallons of the sulphate of copper mixture; but remember, too, as the Doctor was very particular about stating that, a teaspoon evened off, not heaped. That is what he called a teaspoonful.

One word in regard to the plum. Reference has been made to the Japan plum and its value. This is a matter of my own experience. I have three or four varieties, some trees that I planted a year ago last spring. I had a very good crop of plums from them. The curculio has no effect whatever upon them. It punctures the fruit and deposits its egg, but there is an acid in the fruit, and that, I suppose, prevents the hatching of the egg.

Secretary SESSIONS. I want to say just a word. Dr. Fisher's name has been mentioned here. He gave us a paper upon orchard management four years ago;* also an account of his practice in spraying will be found, if you look for it, in the report of 1891.†

Mr. STETSON. I would like to ask Mr. Wood if he does not think the Roxbury Russet is more liable to be attacked by the codling moth than other varieties of apples? It is so with me.

Mr. WOOD. I presume Mr. Stetson has in mind the fact that the Roxbury Russet bears more on the off year than any other variety, and on the off year there are more moths in proportion to the apples than in an abundant year. I think if you will examine them when you have an abundant crop of apples you will find the Russet will average fairly with the others.

Mr. STETSON. It does not make any difference with me.

Mr. WOOD. You know the Roxbury Russet does not bear so heavy a crop as the Baldwin and Greening varieties, but it will bear more on the off year. You will get some apples every year from them. Of course, as I said before, they are not as fair unless there is some spraying preparation for preventing the insects from doing their work, which they are sure to get in, but I do not know that there is any difference about their being more susceptible to the work of the insects. I never heard it mentioned.

QUESTION. When is the best time to trim a tree?

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* "Agriculture of Massachusetts," 1889, p. 11.

† *Ibid.*, 1891, p. 148.

Mr. Wood. Any time when you have time to do it; but the wounds will heal over more easily if trimmed in the beginning of the season when it is beginning to make its growth. A good practice for farmers who do not have time in the spring is to go over them in the winter, and the small shoots starting out from the main limbs and any small interlacing limbs can be taken out at any time; but if there are any limbs of any considerable size they should be sawed off from four to six inches from the body of the tree. If you saw them off close to the tree, unless you are very careful, when the limb breaks down as you are sawing it is very liable to take a strip of the bark down with it, which makes a bad wound in the tree. But if you saw them off six or eight inches from the body, then it is a very easy matter to go around with a saw and take off those stumps close to the body of the tree. That is the safest and best way to take off limbs of any size. If you do not grow more than four main branches from the trunk there will be very little occasion to cut off limbs of any considerable size. The trouble comes more from allowing limbs to grow so that they interlace, and when they do you have got to cut them away.

Question. I would like to ask Mr. Wood the name of the insects that attack the quince?

Mr. Wood. The only one that I know of which troubles the quince is the borer which gets into the bark.

Question. And what would you do in case they attack the tree?

Mr. Wood. I should watch and dig them out. I do not know any better way. The borer is the worst enemy that the quince has.

Mr. F. W. Sargent (of Amesbury). There is one reason I would recommend for setting an orchard on a hill which Mr. Wood has not stated, and that is, to utilize our hills for some other purpose than pasturing cows, for I am one who does not believe in keeping cows in pastures at all. We know that it is very difficult in many cases to get the manure on the high hills and hillsides, and I would like to know if it would be policy to set an apple orchard on a hill or hillside without any fertilizer, or if we could use chemicals to a profit in doing so?

Mr. Wood. That is one of the advantages that may be derived, for most farmers grow their apple trees on land, as I stated in my paper, which is of very little value for any other purpose. A stony piece is of no disadvantage only in cultivation. Of course, you can cultivate a piece without stones in it, but they are a good deal of benefit to the trees. There is a constant disintegration going on in the small boulders in our soil. If you dig up an apple tree where there was in the ground a lot of boulders, you will find roots will cling to those stones as they will to a decaying bone. They get moisture and they get food from the stone. In fact, one of the best orchards, as it was said to be, in the State for years, where the fruit brought the largest price, was in Dracut, near Lowell. The ground upon which the trees grew was so stony that they could not plough it, and the owner used to cultivate it with the hoe. He kept it under cultivation all the time, and did it by hand. He was growing the best fruit, and was among the best growers that sent fruit into our Boston market.

In regard to growing them without any fertilizer, I should not want to try to grow any trees without a fertilizer. I claim that there is no farm product which will return as much money in proportion to the amount of fertilizer required as an apple orchard. As I stated before, it is a biennial crop, as a rule. The trees take every other year to recuperate from bearing a full crop, and I think if you have land, a side hill, that will produce under ordinary culture forty or fifty bushels of corn to the acre, if you will get that into condition and keep it under cultivation, putting on as much manure as you take off in crops, until those trees come into bearing, if you won't allow a grass crop to come in and take all the nourishment from the roots by intercepting it, but give it the benefit of the air, and pick your crop every other year, it will give you a good crop of apples with very little expenditure for fertilizer.

Mr. Wm. Bancroft (of Chesterfield). I had a pasture which I did not think was worth ploughing, which was very stony, not particularly rich, almost without verdure. There were at least one hundred or one hundred and fifty apple trees that came up scattered all over it, and the size might be about six inches. Five or six years ago I got a man for $2 a day to go on and graft those trees. I think the chances are altogether in favor of our picking next year fifty barrels of apples from those trees. I think we picked about thirty this year, and it is the off year.

Mr. LYMAN (of Southampton). Here in western Massachusetts there are granite ledges where the ground can be utilized for trees, not in a regular orchard, but in corners where the soil is rich but is difficult to plough, and which cannot be used for any other purpose except a sheep pasture, perhaps. I have in mind one such orchard where it was said that no trees would do well, and the owner gets a good crop of nice apples there, and without any other fertilizer than the sheep furnish which are pastured there, and I think apples grown upon this rocky, granite soil are much nicer than those grown on low and sandy soil.

Secretary GOLD (of the Connecticut Board of Agriculture). Several things in the discussion to-day have interested me very much, and I may be able to add something to some of them. Why should we plant orchards on hillsides rather than on lowlands? We have had examples within the last few years that furnish pretty good evidence that the hillside orchards are better than those in the valleys and upon level lands. We have had frosts that have destroyed the fruit over a large section of our intervale land, and reached on toward the hillsides sometimes by a straight line right across the field from the lower lands to the orchards. The fruit has all been killed, while on the upper portion we have had a good crop. We have seen some effects upon the forest trees of the same kind where the lower limbs were killed. Some ten or fifteen years ago we saw it all about. The lower limbs were killed by the frost, and the tops of the trees were perfectly safe. I have seen that in apple trees. The lower limbs were divested, not bearing apples, while the top of the tree, the crown of it, was loaded with choice fruit. Now, if we had gone up the hillside a little further the whole tree would have been productive.

With regard to the Baldwin being so perfectly hardy, it is upon our hills and heavy land. When rightly treated it is as hardy as any tree, more hardy, but there are some conditions under which it fails. You recollect some dozen years ago when we had that terrible winter that affected our farmers and their fruit trees so injuriously, and especially our Baldwins planted for hedges and other purposes. The Baldwin upon our hills remained perfectly healthy and sound, but in our valley locations, with a warm, gravelly soil, whole orchards were destroyed. There were a good many reasons given for this destruction of trees that winter, and the conclusion seems to have been that the soil was very dry. We entered the winter with scarcely any water in the ground, and we had zero weather for several days in succession, accompanied by a most piercing, drying wind. It took all the moisture out of the top of the tree and the roots were unable to supply any, and they died in these places; but in their natural situations the evergreens on our hills, in their heavy soils, survived. There is one argument in favor of the Baldwin which has not been noticed here. The fruit will bear more abuse and rough handling than anything that I know of except what we call the pig apples or cider apples, something of that kind, and come out fairly in good condition. You can pick more Baldwins probably and handle them so that they will pass into the market in good condition than any other varieties that I know of. Occasionally we have a Greening tree that bears uniformly good fruit, so that a man will get as many barrels as from a Baldwin. I have a variety of trees, I am sometimes ashamed to say, of grafted fruit on my farm, put in for my amusement in part, and partly with the idea that I may persuade people to use some apples that are better to eat than the Baldwin and the Greening, better to cook, but they do not keep up with me in my idea in that respect, and they say, as Mr. Wood has properly reminded us, these more salable varieties are the ones to be planted for profit, of which there is no doubt; but if you want varieties to use on your farms you want somewhat of a different selection, many of which would be a failure in trying to raise for the market.

In regard to this matter of spraying, it would seem to me that Mr. Cruickshanks gave the amount of Paris green rather more than scientific experimenters would warrant in their instructions, and that the amount he describes, one teaspoonful to three gallons of water, would seem to me to be a pretty heavy allowance of Paris green as applied to the foliage.

Mr. Cruickshanks. Dr. Fisher found no trouble with the apples.

Secretary Gold. Well, in careless management the Paris green settles to the bottom of the vessel.

Mr. Cruickshanks. It requires to be kept stirred up.

Secretary Gold. You have got to keep it continually stirred, and perhaps in that way a teaspoonful to three gallons of water might not be too much; but in the hands of an ordinary laborer, if you put a teaspoonful into three gallons of water, you will get almost a half a teaspoonful in the last gallon, and then you will affect the foliage of the trees.

I am pleased to have this matter of the cultivation of fruit set forth so fully, believing, as I do, that there is no branch of New England agriculture that we can pursue more profitably and which will be more satisfactory to the pursuer than that of orchard culture here in New England.

Secretary Sessions. We have with us a gentleman of a good deal of experience who has come a long distance. I want to hear a few words from Mr. James Draper of Worcester.

Mr. Draper. Mr. President and gentlemen, it has been my good fortune to be associated with Mr. Wood for a great many years in different lines of horticulture. I have followed him around to different gatherings of this character, and it has been my part to watch the progress of meetings and not allow them to drag, and if I found there was any opportunity to supplement his good words from my experience, to drop in some little hints to keep the meeting lively. But where has been the opportunity at this meeting at Great Barrington for any one to find an unoccupied moment, which I consider has been one of the most successful meetings held by the State Board of Agriculture? But, my friends, you are open to this one censure. Your meetings have been called invariably from half an hour to three-quarters before you began. I think that is a mistake. Farmers should be taught punctuality as much as they are taught other things.

Allusion has been made to me as a nurseryman. Perhaps twenty-five years of my life have been spent among trees. It is very natural for a nurseryman to have a large variety of fruits and flowers and shrubs and different lines of ornamentation to carry along his work successfully. In the line of ornamentation I will admit that it is desirable for us to have a wide range, adapted to different purposes, for different effects, for different soils and different situations, climatic influences and prevailing winds; but when you come down to the matter of fruit culture, there is where the nurserymen and tree peddlers have made a great mistake, and have done injury to the farmers of New England. Why, you know how they do. A man comes to your door with a beautifully colored plate of some variety of fruit that he only has the secret of — it may be a plum which grows upon a tree that will withstand the black knot, and the plum is of such fine texture or is so firm that the curculio will not sting it, and so he sells you that tree for a dollar or two or three dollars, and you set out your orchard expecting those results to come from it. Do you know, my friends, the curculio is a pretty good judge of good fruit, and he won't touch those fruits; they are so poor that the curculio won't strike it. Such trees certainly will never meet the approval of the horticulturist. That is only an illustration. It is the same with peaches, grapes, pears and apples.

I think the State Board of Agriculture is doing a great service to the farmers in this matter of judging by the scale of points. I will touch the line of fruits. It was my privilege to be associated with Mr. Wood in arranging the scale of points for fruits and of making some suggestions in regard to their exhibition, and the State Board has done you a great good in confining you to a few specific varieties. Five have been named, and our Worcester society sustains the same varieties and thinks that is a sufficiency. Think of the waste of my friend Gold with his ninety-five other varieties, for only the pleasure that he gets out of them! So I say, let this one lesson go out from this meeting of the State Board in the matter of the cultivation of fruit: Have as few varieties as possible, and put your whole effort into that direction and make a success of it.

In this matter of judging by points, those of us who have had experience are called experts, but a good many of you in your experience find it very difficult to judge collections because the tests of one individual may differ from another, and there are never two collections brought in which are of precisely the same conditions ; besides, many times the judgment is made as to quantity, and the award is given to the person who brings in the largest variety, rather than the best. So I think we want to discourage the idea of collections in all of our exhibitions in Massachusetts, but bring it up and put Baldwins by Baldwins and Gravensteins by Gravensteins. If there are twenty or thirty or forty exhibitors, and the more the better, their fruit side by side, by such tests you can judge them intelligently and equitably, and you are doing a great deal of service, in my judgment, to the horticulture of Massachusetts. There are some varieties that are of no use only to count. There are too many varieties, as was said by my friend, upon the market for profit, and I think our horticultural society is doing a good work in coming down to a scale of points, and also encouraging but a few varieties.

Now, I have talked at random, but I think those are a few points that are worthy of careful consideration and attention.

Mr. J. C. NEWHALL (of Conway). Formerly we used to raise peaches very abundantly all around Massachusetts, but of late years we cannot raise any. When I was in Chicago in the Massachusetts Building one morning with a friend, he said, "Here are some peaches which have come here this morning." I looked at them, — the most magnificent basket of peaches I ever saw. Said I, "Where are these from?" He said, "These came from Massachusetts, and got here this morning, a new variety." They were said to be the Crosby peach, and I want to ask Mr. Wood if he knows anything about them.

Mr. WOOD. Yes, sir. They made their appearance, I think, on our tables three years ago this last season, and it is claimed for this variety that where it has been set in the orchard side by side with the old varieties, in seasons when the fruit buds on the old varieties have been substantially all killed it has produced a very satisfactory crop.

We have a gentleman in Somerville with limited ground, but all through the seasons 1883 to 1887, when Mr. Hale of Connecticut was trying so hard to get peaches from his orchard and did not succeed a single year, that man had peaches for our tables every year, and handsome specimens, all grown from seedling trees. Therefore I believe we have got to get back to first principles. I do not believe there is anything in our soil or climate or anything else because of which we cannot grow peaches just as well as when we were boys.

Mr. E. CUSHMAN (of Lakeville). In regard to peach culture, I wish to say that within sight of my house there are forty acres of peach orchard owned by a gentleman from Geneva, N. Y., and he bought on the shore of Lake Samoset about one hundred or one hundred and twenty-five acres of what you would call the nicest pasture land, land there is an abundance of in Plymouth County, and growing sweet fern and wild grasses. He ploughed that land and set these trees with a good deal of care. The native residents were scoffing at him, wholly incredulous, assuring him he never would get a peach to a tree. It was my good fortune last spring to travel through the Middle States at the time the peach orchards were in blossom. I saw some beautiful sights, I assure you, but on my return home about a week later this orchard was in blossom, and I saw no more healthy orchard anywhere in the Middle States than I saw in my own township. That orchard has been fertilized wholly by chemical fertilizers, about two quarts of fine-ground bone and about a quart of muriate of potash, and thoroughly worked into an excavation of about six feet in diameter for each tree. The gentleman spent a good deal of money setting out those trees, but his foreman, in conversation with me, told me this fall that notwithstanding the crop was injured very much indeed by a high wind that swept over our county, and, I suppose, all over the State, blowing our apples and peaches and fruit in some sections entirely to the ground,—notwithstanding, I am told that the two crops three or four years from setting out had paid for all the labor and the land. He has had no trouble at all. There is no indication of the yellows. It looks as if the orchard would be a great success. He bought his new baskets by the car-load two years ago, and that fruit was put into those new baskets and sent away to market. I believe that we should renew our cultivation of the peach, and that we shall see peaches lying upon the ground in our gardens as we saw them in our boyhood.

But, gentlemen, that is not the fruit in which we are the most interested. I have been particularly pleased with the paper this afternoon. It seems to me that we cannot overestimate the value of the red apple crop here in Massachusetts. Our Massachusetts farms lie directly in the centre of the great red apple belt of the world. Go where you will, you will not find the Baldwin apple maturing with that peculiar flavor and size that it matures with here in New England. North the red apple grows smaller and to the south it does not do as well, but in New England the Baldwin reaches its perfection.

In our eastern section we hear a great deal about the cranberry crop, and a very large part of the cranberry crop goes to foreign countries, where the fruit is not grown. The apple growers of New England have no necessity for any large expenditure to introduce the apple in foreign places, for there is no place on the face of the globe where the apple is not appreciated. Carry it where you will, wherever it is known it is sought with an eagerness that surpasses our relish for the fruits of the tropics; so that I say, brother farmers, let us make the most of this, our great blessing. We can cover the hillsides of New England with Baldwin orchards, and at the same time we can keep three varieties of farm stock which to-day are acknowledged to be the most profitable variety that we can keep on our farms. I refer to sheep, swine and poultry, which can be kept in connection with our Baldwin apple orchards. In fact, poultry can be kept with better success where we have fruit trees than where there are no fruit trees. We cannot, I say, overestimate the value of the crop that has been recommended in the paper, and I have been particularly pleased, and I know that as an incentive to the farmers of Massachusetts it will result in great value.

Mr. ———. I want to ask a question. In setting out an orchard, among other varieties of apples I tried Roxbury

Russets twenty-eight years ago, and I have been surprised that in the past ten years there have not been ten bushels of good, fine apples, and I would like to inquire if others in this neighborhood have succeeded in raising Roxbury Russets with any success. If they have not, it will not be advisable to set out Roxbury Russets in that part of the county.

Mr. Wood. I do not know personally as to fruit growing here, but the Roxbury Russet in the towns of Sherborn and Holliston and some parts of Milford is probably the most profitable apple they grow. It may be it is owing to the difference of locality. I have some two or three trees on my own place to supply a local demand, but the Baldwin is the most desirable variety.

Mr. Pratt. If you were going to recommend a man to set out an orchard to-day for market purposes, would you not recommend him to set out entirely the Baldwin apple?

Mr. Wood. In my paper I recommended the varieties I would use in an orchard, but I would set out more Baldwins than any other.

Mr. Cushman. With me the Golden Russet has been a good success, but the Roxbury Russet has never been a success. The codling moth attacks them more than any other apple I have.

Mr. Wood. There is a new variety of Russet down in Acton that is very promising, called the Fletcher Russet. It was shown at the Bay State Fair in Boston. Mr. Augur was there from Connecticut and was very much delighted with it, and I think engaged scions at that time. Whether he has grown it or not I do not know. It has been shown by the originator, John Fletcher, and Mr. W. H. Teele, either of whom I have no doubt will furnish you with scions. It is larger than the Roxbury Russet, of handsome form and good quality, and it will keep as well as the Roxbury Russet.

Mr. Millard. I would like to ask as to whether it is better to buy our trees at home or abroad.

Mr. Draper. The trouble is not with the trees that we buy from the travelling salesmen. The trouble is with the way the business is conducted. If I wanted to buy nice apple trees, if I could get the varieties I wanted, I would buy them direct from Stephen Hoyt & Sons of Connecticut, because I consider they are growing the finest apple trees that can be found. It may not surprise you to know that they sometimes furnish a great many apple trees that go to dealers in New York and come back again to New England from Geneva and Syracuse. As I said, the trouble is the way the business is done. A man takes an order. His business is not like handling other merchandise; it is handling live stock. They are not subject to the same abuse in transmission, so that, to carry on the business of a large line of canvassing jobbers, they employ canvassers, and the canvassers take the orders and send them to the jobbers, who pack them to different parts of the country, and these persons who sell to you take your orders, and usually somebody else delivers the goods. That seems to be one of the peculiarities of the business. It is impossible to do the business in the short time that they have at their command. They have only five or six weeks in which to do the business of the year, while every other kind of merchant has twelve months to do his business. Thousands and hundreds of thousands of trees, vines, shrubs and plants have been packed, and are to-day in cold storage, in cellars all through the fruit-growing region of New York State, and as early as the middle of February the orders from the canvassers will be sent to the general head, and wherever they may have established their packing quarters the work of packing begins all through the month of March. If you go into those places you will find them filling orders from all over New England. They are packed carefully and done up in straw, and packed in cases and marked for the places that they are to go. Then they are started along about the first of April, or as soon as it is safe to ship on account of frost. You will find these boxes at the railroad stations all over New York, and a week or ten days sometimes will pass before a person comes to deliver them, so that the trees are not dug fresh from the soil. It is an utter impossibility for the men to do it, so they are two months out of the ground; they are two months in the packing boxes many times before they are distributed. And then the man that handles them goes and unpacks the box, and sets them all up around the stable or wherever the place may be, and many times puts them out right on the ground, left standing in the dirt, where all the vitality is taken out of those trees, and so there is a disadvantage of buying trees of the canvassers. Now, I say, buy direct from some reliable nurseryman in whom you have confidence, insist upon spring trees, and you will save ninety-nine out of every one hundred trees you buy. On the other hand, speaking from experience, 75 per cent of the trees sold the other way are not worth a cent in three years' time.

Mr. Millard. The point that I desired to draw out was this: whether home-grown trees or foreign-grown trees which would be in a way congenial to our soil here might be the best for us to use.

Mr. Draper. I think it makes but very little difference. If you take a tree growing in Genesee Valley in New York State, where the roots strike down two feet, and get just two or three roots down deep in the soil, they can make an immense growth, three feet, perhaps five feet the first year and three the second, according to the special growth of the tree I would want; but tens of thousands of these trees are grown by farmers in New York State on high land. If you take a tree growing on good ordinary soil and give it a good root and a good fair growth of body, a good growth of wood, you will have as good a tree from New York State as from New England, but do not take the trees grown in rich bottom land, where they get a three-year-old tree in one year.

Question. Mr. Chairman, I would like to ask Mr. Wood, considering the probability that a good many people never will buy trees at all, even of Mr. Draper, whether it would not be advisable for our young people to raise them in their own gardens or on the farms, where our boys and girls can raise hundreds of apple trees and delight in their employment. They can take them up when they please. I mean they can take them up when they are ready, and put them out in the orchard, and thus prevent exposing them very much. I do not want to dispute anything Mr. Draper has said, but, after all, if these trees were home-grown and we should put them out we should have orchards, and nurserymen might sell more than they sell now.

Mr. Wood. Children can be induced to go into no better employment than growing seedlings, and they can be grown on any farm, requiring very little attention. They require transplanting when one or two years old, and have the tap root cut off, causing the roots to branch out near the surface. They should be set in rows one foot apart, and are early budded or grafted. Care should be taken to keep the trunks straight, and if given good cultivation may be set permanently in the orchard when three years old from the bud. In selecting trees you examine the heads carefully to see that they have a nice form, but pay very little attention to the roots. Now, in buying an apple or a pear tree I very seldom look at the head at all except to see it has not been maltreated. If you will set out your tree so that the roots will run near the top of the ground, the head may be formed after the tree is set out. It is the root that needs attention. After you have planted your tree the roots are beyond your control, but the head is above ground and may be easily grown to any desired shape.

Mr. Joseph S. Perry (of Worcester). Mr. Chairman and gentlemen, I have been an interested listener to the remarks made. I have had considerable experience in regard to growing fruit for the last thirty or forty years. That is, my father before me was a large fruit-grower, and within the last three or four years, in my old age, I thought I would start an orchard myself, so three years ago this last spring I bought a very fine piece of hill land and manured it very well, and raised mostly corn. I raised a little over 3,000 bushels once on twenty-two acres. Well, the next year, that was last fall, I manured it again. The second year I planted fifteen acres of corn, and I had 1,700 bushels of ears of corn on the fifteen acres, and I raised four acres of cabbages. I planted my trees this last spring. I set out 1,035 trees, and every tree lived. There was one that got pulled up. There were 1,034, and every tree lived. Very few have grown less than six inches, and a few a foot and a half. This year I am manuring this land, and am going to continue to cultivate and manure for a series of years until they get up to bearing condition, if I live. Of course, I cannot tell how I shall succeed. As one gentleman said here to-day, I have done it for the fun of it, and I am certainly very much pleased with the appearance of this year's growth. I shall endeavor to keep on the same way that I have begun, manuring and cultivating.

Mr. WOOD. What varieties have you?

Mr. PERRY. I set out a good deal according to your recommendation. I set out 1,035 Baldwins.

The CHAIRMAN. We have now but a very few minutes, and I want to hear from the Secretary.

Secretary SESSIONS. I suppose, Mr. Chairman, it is about time to bring this meeting to a close. I do not propose to add anything to the discussion specially before us, but I want to say to you, as representing the Great Barrington people and the Housatonic Valley and South Berkshire, that I believe the Board considers this one of its most successful meetings. In the matter of attendance we are more than pleased, although, of course, we should have been better pleased with a little larger audience to-day; but I understand that is considerably accounted for by the annual meeting of the Berkshire Society at Pittsfield, of which many farmers in this vicinity are members. The record has been kept of the attendance at these public winter meetings since 1887, and I asked my clerk, who is familiar with those figures, to give me an estimate of how the attendance through this meeting compared with those we have had since then, and it is very much in favor of the Great Barrington meeting. I say this that you people of Great Barrington, while you may feel that you have not done all you ought, may feel that you have given a creditable reception to the Board and have had a well-attended meeting. I think that the Board should express its thanks to the Housatonic Society and the people of Great Barrington for the manner in which we have been received, and if one of the members of the Board will make the motion, the chairman will put it, I have no doubt.

Mr. CUSHMAN. Mr. Chairman, before this meeting shall close, as a member of this Board from the extreme limit of the Commonwealth, I wish to make a motion that this Board express to this Housatonic Valley Society and to the people of Great Barrington generally its appreciation of their kindness, of their hospitality, and of their cordial greetings; that we fully appreciate the pleasantness of our visit here and our accommodations, and that we leave with the kindest feelings to all.

(The motion was unanimously adopted.)

The Chairman. I wish to make one statement about what has been alluded to by the Secretary, by way of explanation why the audience of to-day is so much smaller than it was yesterday. To-day is the annual meeting of the old Berkshire Society, incorporated in 1811. There are questions of vital importance to come before that society for action, and many gentlemen have gone to that meeting who otherwise would have been here to-day, although I see a great many here to-day whom I did not expect, and I hope you will accept this explanation, and understand that their absence is not due to any want of respect for the Board.

Now, gentlemen, in behalf of the Housatonic Society and in behalf of the citizens of Great Barrington, I return thanks for the acceptance by the Board of our invitation. Hoping and wishing, gentlemen, that I may hear of the safe return of each and all of you to your homes, we will call this meeting dissolved.

# REPORT

OF THE

# STATE BOARD OF CATTLE COMMISSIONERS.

JANUARY 4, 1894.

# REPORT

OF THE

# STATE BOARD OF CATTLE COMMISSIONERS.

*To the Honorable Senate and House of Representatives.*

The State Board of Cattle Commissioners beg to present the following report of their work for the year 1893: —

In accordance with the demands of chapter 58 of the Public Statutes, as amended in the Legislature of 1892 by a law entitled "An Act to more effectually prevent the spread of tuberculosis" (see Appendix A), the work of perfecting the corps of inspectors throughout the State, which had been commenced in May, 1892, was continued with as much vigor as was possible, but with rather discouraging results, because the officers of many of the cities and towns affected to believe that the provisions of the law were not to be earnestly enforced, and therefore the attending expense was one that could be avoided as well as not until June 3, when the provisions of chapter 306 of the Acts of 1893 came into force, making it possible for the Commissioners to appoint inspectors in such cities and towns as did not comply with the provisions of the several acts, and to compel such delinquent towns to pay the salaries of such inspectors from their own treasuries (see Appendix B).

Shortly after the passage of the act of 1893, namely, in May, the following circular was prepared, and, together with a copy of the new law, sent to the proper officers in each city and town throughout the State: —

BOSTON, May, 1893.

GENTLEMEN: — The duties of cities and towns in relation to their work in suppressing and preventing the spread of contagious diseases among domestic animals has been somewhat more clearly defined by a recent act of the Legislature, a copy of which is herewith enclosed.

The Board desires to call your especial attention to sections five and six of said act, and also to the necessity of immediately appointing efficient inspectors, if it has not already been done.

Shortly following this, namely, in June, the new law going into effect June 3, the following circular letter of "Instructions to Inspectors" was prepared, and a copy sent to each one of the inspectors, so far as their names and addresses were known at this office: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
SECRETARY'S OFFICE, 50 VILLAGE STREET,
BOSTON, June, 1893.

The Board of Cattle Commissioners having been requested by several of the cities and towns of the Commonwealth to define the duties of the inspectors of "animals intended for slaughter or kept for the production of milk," so far as such duties relate to the business of this Commission, beg to present the following

### INSTRUCTION TO INSPECTORS.

#### *How they are Appointed and Removed.*

1. Inspectors are to be appointed annually in the month of April, by the mayor and aldermen of cities and by the selectmen of towns.
2. Whenever such appointments are not made, the Board of Cattle Commissioners have the power to appoint such inspectors.
3. The officers of the city or town may remove any inspector appointed by them who fails to be sworn and faithfully perform his duties.
4. The Board of Cattle Commissioners may remove any inspector for the same cause.

#### *Duties in Relation to the Work of the Cattle Commission.*

5. The duties of the inspectors include an examination of all animals kept for the production of milk, all animals intended for slaughter, and all meats that are found, or exposed for sale, within their districts.
6. An inspector may, for the purpose of inspection, enter into all buildings or enclosures where such animals or meats are kept, stored or exposed for slaughter or for sale.

7. Whenever an inspector finds any meat that in his judgment is tainted, corrupted or unwholesome, he should seize and destroy the same, unless at the time of such seizure the owner of the property notifies the inspector in writing that he desires to appeal to the Board of Health. It is then the duty of the inspector to immediately cause such property to be inspected by the Board of Health, or a committee thereof, consisting of not less than two members.

8. Whenever an inspector finds an animal which in his judgment is diseased, he should immediately notify the local Board of Health and the Secretary of the Board of Cattle Commissioners of the fact, stating the supposed disease.

9. The law has defined the contagious diseases to be glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot and mouth disease, rinderpest, hog cholera and rabies.

10. Whenever an inspector is prevented, in the exercise of his duty, from entering any premises, he should not use force, but should make complaint before a police, district or municipal court, or magistrate authorized to issue warrants in criminal cases, whenever he believes that any diseased animals, or diseased or unwholesome meats, are kept or concealed in any particular house or place with intent to kill, sell or offer the same for food. And such magistrate can issue a warrant for the search of such animals or articles; and inspectors should see that persons infringing the law in this way are properly prosecuted.

11. An inspector who fails to notify his local Board of Health of the suspected existence of a contagious disease, or who fails to comply with a regulation made or order given by the Cattle Commissioners, is subject to a fine not exceeding $500, or imprisonment not exceeding one year.

### *Examination of Herds.*

12. All herds within your district that are engaged in the production of milk, or in which there are animals that are being fattened for beef, shall be thoroughly examined by you as often as once in each three months.

13. If they are found to be entirely free from disease, the same is to be certified by you upon a blank which will be furnished from this office, which blank shall be given to the owner of the herd, to be used by him for his own advantage. You will also send the required certificate to this office, and keep your own memorandum of the date and the result of the inspection.

14. If, on the contrary, tuberculosis is found to exist in the herd,

each animal showing it shall be isolated on the farm, or in some other convenient place to be selected by you, and quarantined there, under the authority of the local Board of Health, who shall at once notify the Commissioners. The milk from such isolated animal shall not be sold, and in such instances the certificate of health shall not be given for the herd; or, if it has been previously given, it shall be withdrawn. Animals that have been quarantined should not be killed except by the permission of the Board of Health imposing such quarantine, and in your presence, as their inspector, or in the presence of an inspector appointed by them, who will at once certify the death and its cause to this office. An animal destroyed in this way cannot be paid for by the Commonwealth under any circumstances.

15. Whenever you have reason to believe that any new animals have recently been introduced among a herd, or when from any reason, at any time, you have cause to suppose that disease exists in a herd, a re-inspection shall be made at once, and the directions already given shall be followed.

### *General Directions.*

16. All suspected animals must be placed in quarantine before the Commissioners are called.

17. Inspectors must make complaints of individual animals, not of herds in general.

18. When directions from boards of selectmen, boards of health, or the Board of Cattle Commissioners conflict, those of the Cattle Commissioners must take precedence.

### *Butchers' and Meat Dealers' Establishments.*

19. Report to the Commissioners the locations of all slaughter-houses within your district; give the name of the butcher, the class of animals killed, the days of slaughter; say where the animals to be killed are obtained, and where the general market is sought.

20. As to the periodical inspection of these slaughter-houses, and the destruction of any meat that may be considered unfit for human consumption, direction and action are to be taken from your local Board of Health.

21. When, however, tuberculosis is found to exist in a carcass, great endeavor is to be used to find the herd from whence the animal came; if the beef is of local production, or otherwise; the town, State or cattle market from whence it was procured; and a report as to the facts made to the Commission.

*General Suggestions.*

22. If for any reason you desire to know the name and the address of the inspector for any town within this Commonwealth from which animals may have been removed to your district, you can obtain the same by application to this office.

23. Notify this Board of your action promptly.

24. Notify this office of the number of blank certificates that you will possibly require.

Levi Stockbridge, *President*,
Charles P. Lyman, F. R. C.V. S., *Secretary*,
M. O'Connell, D.V. S.,
*Board of Cattle Commissioners.*

Among the earlier attempts made by the Commission to get at the probable existence of tuberculosis among cattle, was an order directing that all herds should be examined as often as once in every three months; and that, each time, the office should be notified of their actual condition, upon blanks which were furnished for the purpose. After trial of this order, for something more than a year, the Commissioners became convinced that the midsummer examinations were practically useless, because of the extreme difficulty of reaching anything like the total number of animals at this time; and that the midwinter examination would not repay its cost; provided a thorough examination of all of the animals could be made in the fall as soon as they had been brought into the barns, and again in the spring, just before they were turned out to pasture. Therefore in September the following order was made, and the inspectors notified of the change: —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Secretary's Office, 50 Village Street,
Boston, September, 1893.

Dear Sir: — I beg to call your attention to the following vote recently passed by the Board of Cattle Commissiomers, and to ask that the inspections therein called for are properly, carefully and thoroughly made; and that you report the results of your examinations to this office, upon the proper blanks, within as short a time as possible after the completion of the work.

At a meeting of the Board of Cattle Commissioners held Sept. 27, 1893, it was voted that "hereafter inspectors be ordered to make two thorough examinations of cattle in each year: one during October, or as soon as possible after the animals come in from pasture; the other during April, or just before the animals are turned to pasture. That inspectors also be ordered, and advised, to make inspections of any herds of animals within their district whenever any emergency arises, or whenever, in their judgment, because of numerous changes or otherwise, it is better for the service for them to do so."

By order of the Board,
CHARLES P. LYMAN,
*Secretary.*

*To the Inspector of Animals, etc., in* ———.

This order met with the decided approval of the inspectors, in that it saves them a great deal of hard, unsatisfactory work; and with the town officers, in that it reduces the cost of inspection by more than one-half, for both inspections can now be made within about the expenditure of time formerly required in the summer inspection alone.

While in these ways the interest of the officers of many of the towns had been gained, and good work was being done under their direction, there were still so many towns (nearly half) that had not, so far as the Commission were aware, complied with the provisions of the law, that in October it was deemed necessary to issue the following order: —

COMMONWEALTH OF MASSACHUSETTS,
BOARD OF CATTLE COMMISSIONERS,
SECRETARY'S OFFICE, 50 VILLAGE STREET,
BOSTON, Oct. 27, 1893.

*To the Mayor and Aldermen of Cities and Selectmen of Towns.*

GENTLEMEN: — At a regular meeting of the Board of Cattle Commissioners, held on Friday, Oct. 27, 1893, it was

*Voted*, That, in the opinion of this Board, in order to extirpate tuberculosis among the cattle of the State, it is necessary that thorough and regular inspections be made of all animals; and the Board being of the opinion that proper inspections have not been made in the following towns, to wit, Acton, Alford, Amesbury, Arlington, Ashburnham, Ashby, Ashfield, Athol, Attleborough, Avon, Barnstable, Barre, Becket, Bedford, Bellingham, Berlin, Billerica, Boxborough, Boylston, Braintree, Brewster, Bridgewater, Brimfield, Brookfield, Buckland, Carlisle, Carver, Charlemont, Chatham, Chelmsford, Cheshire, Chester, Chicopee, Clarksburg, Colrain, Conway, Dana, Danvers, Dartmouth, Dedham, Deerfield, Douglas, Dracut, Dudley, Eastham, Egremont, Erving, Everett, Freetown, Gay Head, Georgetown, Goshen, Gosnold, Granville, Great Barrington, Greenwich, Huntington, Hamilton, Hampden, Hancock, Hardwick, Harvard, Harwich, Hatfield, Haverhill, Hingham, Hinsdale, Holbrook, Holden, Hopedale, Hopkinton, Hubbardston, Hyde Park, Hyannis, Lancaster, Lanesborough, Lenox, Leominster, Leverett, Lexington, Lincoln, Longmeadow, Ludlow, Malden, Manchester, Marblehead, Marion, Marshfield, Marlborough, Mashpee, Medford, Merrimac, Methuen, Middleborough, Middlefield, Milford, Millbury, Millis, Monroe, Monson, Montague, Montgomery, Mount Washington, Middleton, Nantucket, Natick, New Ashford, New Braintree, Newbury, North Andover, North Adams, North Attleborough, Northfield, Otis, Oxford, Palmer, Pelham, Pepperell, Peru, Petersham, Plymouth, Plympton, Provincetown, Quincy, Raynham, Reading, Rehoboth, Revere, Richmond, Rochester, Rockland, Royalston, Russell, Salisbury, Sandisfield, Savoy, Seekonk, Sharon, Sheffield, Shelburne, Shirley, Shrewsbury, South Hadley, Southwick, Spencer, Sterling, Stockbridge, Sudbury, Sunderland, Sutton, Swampscott, Templeton, Tewksbury, Tolland, Truro, Tyringham, Wales, Ware, Wareham, Warren, Washington, Wendell, Wenham, Westford, West Bridgewater, Westminster, West Springfield, West Tisbury, Whately, Williamstown, Winchendon, Windsor, Winthrop, Wrentham, and Yarmouth, it is hereby ordered that these shall be made, within the limits of said towns, as follows: two thorough examinations of all cattle in each year; one during October, or as soon as possible after the animals come in from pasture; the other during April, or just before the animals are turned to pasture. That inspectors also make inspections of any herds of animals within their district whenever any emergency arises, or whenever, in their judgment, because of numerous changes or otherwise, it is better for the service for them to do so; and that the returns of such inspections be made to this Board, upon blanks which will be furnished upon application, regularly, and as soon as possible after the said examinations have been made.

It is further ordered that this regulation be published by sending an attested copy thereof to the mayor and aldermen of cities and the selectmen of towns of each of said towns, and to all known inspectors within their limits appointed under the provisions of chapter 57 of the Public Statutes and acts amendatory thereof.

Levi Stockbridge, *President*,
Charles P. Lyman, F. R. C.V. S., *Secretary*,
M. O'Connell, D.V. S.,
*Board of Cattle Commissioners.*

A true copy. Attest:
E. E. Woods, *Clerk*.

This order has been so well received and acted upon that even within the short time during which it has been in force, out of the three hundred and fifty-two cities and towns there are two hundred and seventy-nine in which the work is being done; and there are good indications that before long nearly all of the remaining seventy-three towns will have begun to comply with the order.

When the magnitude of undertaking the establishment of a large corps of inspectors throughout the State is thoroughly understood, these results, reached within the comparatively short time of eighteen months, are exceedingly satisfactory, and show evidence of an interest in the work on the part of by far the greater majority of the towns of the Commonwealth that promises exceedingly well for the future.

No little difficulty has been encountered by the towns in getting men who are properly qualified to do the work. In a number of cases veterinary surgeons and medical practitioners have been appointed; but in by far the larger number of instances men who have had years of experience either as dealers in or butchers of cattle have been selected; a few farmers, who have had special opportunities, have been made inspectors; while there have been only a comparatively few instances in which the appointment made has not evidenced a desire on the part of the town to do all that it could to get the right man for the position.

The duty of the inspector includes a visit to each place in which neat cattle are kept; these locations, unless they are already known to him, he obtains from the assessors' books. He then makes a thoroughly careful examination of each such animal, and if, in his opinion, no contagious disease exists among them (contagious diseases under the law are defined by section 3 of chapter 306, Acts of 1893), he leaves with the owner the following form of certificate: —

### CERTIFICATE OF INSPECTION.

Town of , month of , 189 .

I hereby certify that I have this day examined a herd of cows belonging to Mr. of this town. I have found no evidence of the existence of tuberculosis, or any other contagious disease, among them, and, in my opinion, milk or meat from them can be used with entire safety by the community.

*Inspector.*

To be filled out and left with the owner of the herd.

If, on the contrary, an animal seems to him to perhaps be the victim of one or other of these disorders, he withholds the certificate, and reports the suspected case to the Commissioners and to the local Board of Health, whose duty it then becomes to examine, and, if necessary, quarantine the animal and notify the Commissioners.

When the examination is completed, a return of it is made to the Commissioners upon the following form of blank: —

CERTIFICATE OF INSPECTION.

Town of , month of , 189 .

Name of owner, . Number of cattle, . Cows in milk, . Bulls, . Cows dry and not fatting, ; Fatting, ; Young, ; Oxen, . Are they free from contagious diseases? . Have you cause to suppose that any of these animals have tuberculosis? . Have you notified the Board of Health of these facts? If so, give date, . How many animals are now in quarantine? . Remarks, .

This blank to be filled out and sent to Boston.

Thus it will be seen that a considerable amount of work must be done which requires that the man should have a special sort of training to enable him to perform; and also that a man who has proved himself to be of good capacity should be retained in the office as long as possible by the town. That there are a good many men now holding the position who are deeply interested in the work, and who wish in every way possible to qualify themselves as fully as may be, is abundantly evidenced by the great number of letters which the Commission have received from them, asking all sorts of questions regarding methods of detecting the various diseases. Indeed, these letters were so numerous, and, withal, evidenced so much intelligent knowledge of the *general* conditions, that the Commission prepared and furnished them with a pamphlet regarding tuberculosis, for their use (Appendix C). As the reports, made upon the blanks already described, are received, they are filed in the office in such a way that the particulars regarding the exact condition of every herd can be told at any time.

The inspectors have reported the particulars regarding their examination of 123,908 head of neat stock.

### Too Much Work.

As the organization of the work of the inspectors has become more and more perfect throughout the State, the amount of work coming to the Commission has grown until at the present time it is perfectly overwhelming, and cannot possibly be done with anything like the promptness which its importance demands, and which any just consideration of the interests of the owners of animals requires. The work of the office takes the whole time of the clerk, and the greater part of that of the secretary. Calls to examine suspected quarantined animals are being received at the rate of something over seven a day. These animals are so scattered over the State, and take so much time to reach and examine carefully, that it is impossible for the two remaining Commissioners to average to reach more than six of them each in a week. As a result, inspectors are harshly criticised by owners; town officers are threatened with suits at law for damages, arising from a prolonged quarantine; and the Commissioners are attacked by all three for not properly attending to their duties. Unless some remedy can be found for this state of matters, before very long, the result will be disastrous.

This probable difficulty was foreseen somewhat last year; and the Legislature then changed the law, which had made it necessary for each animal to be examined by at least two Commissioners before it could be condemned, so that the condemnation can now be made by a single Commissioner. The Board also asked, at that time, that it might be given power to appoint competent agents, in various parts of the State, who could be promptly sent to examine into, and report to the Commissioners upon, such cases as it seemed desirable to treat in this way, for any reason. This request was not granted; and, although the change referred to increased the efficiency of the Board considerably, the event has proved that some further immediate legislation in this direction will be necessary, if we are to continue the work on tuberculosis; that is to say, that, while the new laws have imposed a very greatly increased amount of work upon the Board, they have not increased its working efficiency in any commensurate degree.

If the present law, in so far as it relates to the appointment of inspectors, is to remain in force, there are but two remedies which suggest themselves here; first, enlarge the Board by the addition of a sufficient number of new Commissioners; or, second, devise some plan by which agents, to be appointed by the Board, can be allowed so much freedom of action that the present condition of affairs will not be likely to again occur. There is one possible feature of the agent plan that is worth special consideration, perhaps. The whole State could be divided up into districts; each of these districts could have its resident agent, to whom, through the office of the Commissioners, many of the cases in that district could be sent, and which, in this way, would be reached promptly and at a minimum expense for travelling fees. It is also true that a great many of the calls turn out to be false alarms; these would be ended entirely by a single visit of the agent. As a matter of fact, out of four hundred and ninety-nine cases recently examined, one hundred and four proved to be of this character.

### INDEMNITY.

The present laws of Massachusetts in relation to the suppression of tuberculosis differ so materially from those in some of the other States, and generally for the accomplishment of the same end, that it seems to us, in two particulars at any rate, to be worth while to discuss them, shortly, here.

The Massachusetts laws provide that each town in the Commonwealth shall support one or more inspectors, whose duties have been already sufficiently described; and, further, that all animals that are thought to be diseased shall be destroyed without remuneration to the owner, excepting that in those cases when a post-mortem examination shows that the animal has not been the victim of the disease, as supposed, the owner may be paid its full *sound* value, by the State.

The laws of some other of the States provide that the owner shall in all cases be paid, by the State authority, one-half of the sound value of the animal destroyed; and because of this fact they depend upon the owners of the sick animals to report the existence of the suspicious cases, arguing that, if a man has a sick animal, he will be so glad of an opportunity of selling him in this way that he is sure to call upon the authorities to come and see him.

The practical objections to this last-named method are many and serious. In the first place, there are many cases of tuberculosis found by our inspectors, in animals that are supposed by their owners to be in a perfect state of health. Farmers and dairymen are not generally good judges of animals in this respect, else why are they so often found to have just bought a cow that skilled examination shows is thoroughly consumptive? It is not to be supposed that they would voluntarily do so; and, if these men cannot guard their own interests and protect their own pockets in this respect, they certainly cannot be relied upon to protect the interests of the State at half the price.

Again, it oftentimes happens that an animal with tuberculosis will give a full flow of milk, or take on fat as easily and fully as any healthy animal. Is it likely that the owner of an animal of this sort, even if he knows that he has a consumptive animal, will report the fact for the purpose alone of obtaining a fraction of its value? There are plenty of honest men who will do it, but what of the others who, alas, exist in all communities, who will not call the attention of the State authority to their sick animals, in the absence of any one whose business it is to do so?

The practical working of such a law, in this respect, will be that most of the animals reported will be either of high class or else belong to the other extreme, and that is, have become so far worn out as to be worth less than one-half of their healthy value in the open market.

Further very serious objection, and one that experience has always shown to be inseparable from any law which pays indemnity, is that sooner or later the State treasury goes into the business of buying diseased animals that are collected for the purpose not only from within its own borders, but from the herds of neighboring States as well; and one of two things happens, — either the amount of money expended is so large that the law becomes too much of a burden to the tax payers, and has to be abandoned, or else the State maintaining the law has to institute a quarantine against the animals coming in from another State or States, according to the drift of the incoming cattle trade.

Another serious objection to any system that attempts to eradicate tuberculosis by relying upon owners of animals to report its existence, either with or without indemnity, is to be found in the nature itself of the disease. The contagious principle is not as freely communicated from one animal to another, nor is it by any means as commonly productive of pronounced symptoms of disorder among those which have become its victims, as is that of contagious pleuro-pneumonia, or, in fact, any other of the known contagious diseases of cattle. On the contrary, as has already been shown, it exists over and over again in animals that are to all ordinary appearances in a most perfect state of health; and, further than this, even with such weakly marked indications as to oftentimes baffle the discovery of the most expert practitioner, until by repeated careful examinations it is finally detected. Any law, therefore, that does not recognize this feature of tuberculosis, and meet it, so far as possible, by providing for repeated careful examinations of all the animals by those who have been more or less drilled in its detection, and that animals in which the disease has been discovered shall alone be killed, will most assuredly fail of accomplishing its object. There is no such thing as *stamping* out tuberculosis, it must be *weeded* out; and this process, we all know, needs care, time and patience.

The Massachusetts law avoids these evils, but in so doing sets up another, to its full extent, which has but a, so to say, half existence in the law that pays a half indemnity. It is true that it oftentimes is very hard for an owner to be obliged to lose an animal that he has always regarded as being healthy, because she is found to have tuberculosis; it is hard for men to lose property from any cause; but when it is considered that the use of the milk from such a cow may be a constant source of danger to the members of his family who use it as food, or that the meat, if eaten, may sow the seed of such a disastrous disease as consumption in the bodies of those who may unwittingly eat it, the question is at once changed; and a decision must be made as to whether it is a greater hardship to deprive a man of a piece of property which has cost him forty or fifty dollars, or to allow him to retain it, or sell it, when by so doing the health of many, many people may be irrevocably ruined. If indemnity is to be paid at all, it should be full; half measures produce, generally, half results; and if it were possible to limit the expenditure in this direction to within proper bounds, it might safely be considered that the benefit to the community would offset its cost to them. But it has been so often found that this payment is accompanied by a carelessness on the part of owners, which really nourishes the disease, and that diseased animals are actually imported on purpose to be sold to the State, that such a law defeats itself and become impracticable.

Massachusetts is a large distributing centre for the cattle trade; animals go from here to all parts of New England and to Europe, and its supplies are drawn from a great variety of sources. Were the State to quarantine against all of the sources from which animals with tuberculosis are known to come to us, this valuable trade, which now gives profitable employment to so many, would be ruined. This quarantine, for Massachusetts, is not practicable.

## BUTCHERS.

One of the most serious obstacles to the working out of the law regarding tuberculous animals has been encountered through unprincipled butchers, many of whom are established throughout Massachusetts, as they are throughout many other States. These men make a business of buying up old worn-out or sick cows, many of them tuberculous, for a few dollars each, killing them, and disposing of the meat and other products of the carcass to the best advantage possible to them. In this way a considerable quantity of the meat of tuberculous animals is sold, under various forms, to unsuspecting persons to be used as food. The fact that these men are allowed to continue in this business, practically without restriction, makes it exceedingly easy for those cow owners who are disposed to do so to realize some few dollars each for their consumptive cattle; and, perhaps not unnaturally, certain owners prefer to do this rather than to have the animals seized and killed by the State authorities, from whom they receive nothing in the way of remuneration for the animal. To be sure, after a time, when the present methods of inspection have become more perfect, the supply of this sort of animals will be considerably lessened, perhaps even so much so as to drive a certain small number of butchers out of business (this has already been done to some little extent, in a very few localities); but evidences are plenty to show that when this period has been reached we shall begin to receive this same sort of cattle from some of the neighboring States, as dealers are already collecting them in Vermont and New Hampshire, and shipping them here by the carload for this purpose. So that it would seem to be desirable to make it impossible, or at any rate exceedingly difficult, for these unprincipled butchers to sell meat from the diseased animals.

Section 5 of chapter 58 of the Public Statutes recites, in part, that whoever knowingly sells, or offers for sale, any diseased animal, or any diseased or unwholesome meat, shall be punished by imprisonment for not more than sixty days, or by fine not more than one hundred dollars. The practical difficulty in enforcing this portion of the law is, that after an animal has been killed and cut up it is nearly always impossible to say whether or not the meat has or has not come from a tuberculous animal. If, on the other hand, it can be made possible for the inspectors to be present at the time of the butchering, the recognition of tuberculous animals will be exceedingly easy. It would seem as if all butchers throughout the State could be compelled to take out a license to do business from the board of health in the town in which their slaughter-house is located; and that, without too much hardship, they might be required to name the days of the week upon which they propose to kill animals, together with the time of day at which they propose to commence operations. It can then be made the duty of the inspector to be present at such times to examine the carcasses as the animals are dressed. This regulation would have to be further guarded by the imposition of a punishment for all those who butchered animals without a license; and for any licensed butchers who were found slaughtering any kind of animals at times other than those named in their license, unless they had previously arranged with the inspector to be present. Such a law should also contain a clause allowing any person to kill and dress one of his own animals at any time that he chose to do so, after having arranged with the inspector to be present. This clause should also be guarded by a penalty.

The Board has already a pretty clear knowledge of the locations of many of these butchers, and attempts have repeatedly been made to prevent them from carrying on this illicit trade by bringing the matter to the notice of the local board of health; unfortunately, however, these boards have always appeared to be more anxious to save themselves from any necessity of interfering with the man than they have to prevent the inhabitants of the *neighboring* towns from eating meat that may be unwholesome. The present law, although its intent is plainly manifest, is, as a matter of fact, inoperative because it neglects to provide practicable measures for carrying out its evident intent.

## Brighton and Watertown.

Very much help has been given the Commissioners by the hearty way in which the city of Boston and the town of Watertown have taken hold of the work in the large cattle market at Brighton and at the Union stock yards. Here an inspector is in attendance upon all of the market days, who examines the animals that are offered for sale, and quarantines all that seem to him to show symptoms of consumption or other contagious disease, under the law. This prevents, very largely, the distribution of diseased animals to farmers, dairymen and others who may wish to buy milch cows there. But, unfortunately, the dealers in the sick and worn-out cattle can readily find the means of selling their peculiar wares to willing butchers, without having to bring them to either one of these large markets. This trade is therefore only diverted; and it will continue just as long as the law, which is meant to control it, can possibly be avoided.

## GLANDERS.

Glanders, or its prototype, farcy, has made its appearance in each of the following-named towns: Attleborough, Auburn, Boston, Brockton, Cambridge, Chelsea, Clinton, Concord, Everett, Fall River, Lawrence, Lowell, Milford, Millbury, Natick, Quincy, Somerville, Springfield, Taunton, Westport and Winthrop.

There are good reasons for believing that many cases of glanders exist in the State that are not reported either to the local boards of health, or to the Commissioners; and so long as the law is allowed to remain as now, so that it becomes the duty only of such persons as have good reason to suspect the existence of the disease to report to the proper authorities, this same difficulty will be felt. The greatest part of the difficulty is now found to exist among a certain class of horse dealers and stable keepers who sell horses, as well as among some of those who practice medicine among animals. The first named of these hides the disease so that he may sell the horse to some unsuspecting person; the second sort do not report the case because of indifference, or else because by not doing so they are able to get a few dollars for continuing its treatment for a time, which money would be lost to them were the case reported to the authorities and the animal killed. To be sure, the present law provides a penalty for doing this sort of work; but in order that the penalty may be applied it is necessary to prove beyond a reasonable doubt that the owner or doctor "had good reason to suspect" that glanders existed; and this proof is so difficult to get that the law really amounts to nothing.

Very much might be accomplished, however, by directing that the local inspectors of cattle should also examine any horses that for any reason they may at any time suspect of having glanders or farcy; "such persons" may also be directed, as now, to report cases of suspicions that come within their knowledge. The possible usefulness of some such measure as this was well illustrated during last summer, when a circus company, travelling over the road, made its appearance in one of the towns near the northern central boundary of the State. For some reason a suspicion arose that all was not right with the horses; the local inspector, who happened to be a veterinary surgeon, took it upon himself to examine them, as a result of which several animals were quarantined, examined by the Commissioners and destroyed. In addition to which, the inspectors in each of the towns through which the circus was to pass were notified by the Board of the condition of things; the animals were carefully watched on their entire passage through the State, and several more unmistakably diseased horses were destroyed. Inasmuch as no additional cases of glanders have been reported from any of these towns, it is fair to suppose that no disease was spread from this centre.

## Legislation.

While, as a whole, the Commissioners have made definite progress in executing the provisions of the laws now existing, as already discussed in this report, they feel that further legislation should be passed, in relation to these matters, to perfect the machinery under which the work is to be performed in the future. The progress which has been made during the past year is more largely due to the appreciation by the several cities and towns of the great importance and value of the work, and by their hearty co-operation therein, than to the rigorous enforcement of the law in such places as have failed to comply with its spirit. It can readily be seen that, while much can be done towards limiting the extent of these contagious diseases by the good work of individual cities and towns, these results can be largely negatived by the failure to properly destroy such contagion in the adjoining ones, and that a numerically small number of such could almost render useless the earnest efforts of the large majority of the cities and towns that conform to the spirit of the law.

In working under the law as presently enacted, the Commissioners find, in a general way, that, while it is sufficient to authorize willing cities and towns, boards of health, inspectors and other persons generally to take such action as may be necessary, they have at times experienced considerable difficulty in compelling such authorities and persons who fail to take advantage of these powers to act in such matters.

A further practical difficulty has been encountered by the Commissioners, in that the work to be performed outside of themselves falls upon town officers, boards of health and local inspectors of provisions, the majority of whom have found it very difficult to understand what the law in the matter is, although willing to conform thereto after they have been properly instructed. The reason of this ignorance of the law is two-fold: First, the fact that boards of health and local inspectors are apt to be chosen from a class who have had little experience in the law, and who have little time to devote to the examination of such matters. The second and more cogent reason is that the law, as it stands to-day, is scattered through a large number of acts passed from time to time and to accomplish specific purposes, and without proper care having been taken to make them mutually dependent, so that it requires a legal mind to find these several laws and to understand the powers and duties contained therein.

The machinery for the suppression of contagious diseases today are a Board of Cattle Commissioners, town and city officers, local boards of health, and inspectors of provisions and animals intended for slaughter or kept for the production of milk.

By far the largest part of the work, outside of the Commission, is performed by the local inspectors. These were originally created by an act of the Legislature passed in the year 1876 and incorporated in chapter 58 of the Public Statutes. When originally passed, it was an enabling act only, and applied only to such cities and towns as formally accepted it; and the act is evidently framed to give powers to such cities and towns *desiring* to exercise them, and not to *compel* the performance of such duties contemplated by the act in towns not willing to undertake the same. As originally framed, it had no relation whatever to the Board of Cattle Commissioners, but a slight relation, if any, to the local boards of health. Since this act was passed, numerous amendments have been made to it, covering the inspection of other articles, finally being applied to the inspection of animals kept for the production of milk, which latter came directly under the supervision of the Board of Cattle Commissioners.

In 1885 (chapter 378) the act was passed creating the present Board of Cattle Commissioners, and in 1887 (chapter 252) was passed the act under which they have substantially ever since exercised their functions. While the Commissioners must largely act through the inspectors of provisions, appointed under chapter 58, and upon information and facts furnished by them, the two acts have never been made directly applicable to each other. Again, the act of 1887 imposed certain duties upon and gave certain powers to the local boards of health in these matters, which boards by necessity most largely work through agents. Naturally, these agents would be the inspectors of provisions, under chapter 58, and yet the relations of such agents and such boards of health have never been directly defined by the law.

In 1892 (chapters 195, 400) and 1893 (chapter 306), it was made compulsory upon cities and towns to appoint inspectors according to the provisions of chapter 58 of the Public Statutes; but otherwise the act was not changed, so that cities and towns are bound to appoint inspectors, and yet such inspectors act under a law which is in substance an enabling act only. By this same act, in 1893 the Cattle Commissioners were given direct power over the inspectors of provisions, so that they could remove them where they failed to properly perform their duties, and yet the law is silent as to how far such inspectors are subject to the directions of the Board of Cattle Commissioners. For these and other reasons the Commission feel that all of these matters should be more clearly expressed in the law; and that such law should be so drawn as to compel the few remaining cities and towns, which have not conformed to the spirit of the present law, to perform the duties now willingly performed by the large majority of the cities and towns in the Commonwealth.

They, therefore, recommend the passage of a law covering the matters already referred to in this report, and bringing together and codifying all the laws in relation to the powers and duties of the Board of Cattle Commissioners, and its members; the powers and duties of cities and towns in relation to the suppression of contagious diseases among domestic animals; the powers and duties of local boards of health for the same purpose; the powers and duties of inspectors of provisions and of animals intended for slaughter or kept for the production of milk, and the more clearly defining of all of the same. That such law shall give the Cattle Commissioners and the authorities in the several cities and towns the power to compel the performing of such duties and acts as are necessary or expedient for the suppression of such contagious diseases; shall provide more definitely for the inspection of domestic animals, under the direction of the Cattle Commissioners; shall authorize local inspectors of provisions, under proper regulations, to quarantine animals affected with or suspected of having such contagious diseases; shall provide for disinfecting the premises where such contagion has existed; shall provide a uniform method of quarantine, and for uniform returns to the Cattle Commissioners of all inspections and all cases of contagious diseases; and for the general supervision and control by the Board of Cattle Commissioners over the inspectors of provisions as to all matters within their duties, relating to the suppression of contagious diseases.

LEVI STOCKBRIDGE, *President*,
CHARLES P. LYMAN, F.R.C.V.S., *Secretary*,
M. O'CONNELL, D.V.S.,
*Board of Cattle Commissioners.*

## Appendix A.

### COMMONWEALTH OF MASSACHUSETTS.

In the Year One Thousand Eight Hundred and Ninety-Two.

### An Act to more effectually prevent the spread of tuberculosis.

*Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:*

Section 1. Section one of chapter fifty-eight of the Public Statutes is hereby amended by striking out the words "may annually" in the second line of said section and inserting in place thereof the words "shall annually in the month of April," also by inserting after the word "slaughter," in the third line of said section, the words "or kept for the production of milk," so as to read as follows: *Section 1.* The mayor and aldermen of cities and the selectmen of towns shall annually in the month of April appoint one or more persons to be inspectors of provisions and of animals intended for slaughter or kept for the production of milk. Such inspectors shall be sworn faithfully to discharge the duties of their office and shall receive such compensation as the city council or the selectmen shall determine.

Sect. 2. Said inspectors, in addition to the powers conferred upon them by section two of chapter fifty-eight of the Public Statutes, may inspect all animals kept for the production of milk, and shall report to the board of cattle commissioners all suspected cases of tuberculosis which come to their notice among animals intended for slaughter or kept for the production of milk.

Sect. 3. Section thirteen of chapter two hundred and fifty-two of the acts of the year eighteen hundred and eighty-seven is hereby amended by inserting after the word "of" in the ninth line of said section the word "tuberculosis," and by adding at the end of said section the words "and may also pay a reasonable sum for the animal destroyed should a post mortem examination prove that said animal was free from the disease for which it was condemned," so as to read as follows: *Sect. 13.* When the commissioners, by an examination of a case of contagious disease among domestic animals, become satisfied that it has been contracted by intention or negligence on the part of the owner, or of a person in his employ, or by his consent, or by the use of food material liable to contain the germs of contagion, they shall cause such animals to be securely isolated at the expense of the owner, or they shall cause them to be killed without appraisal or payment; and in all cases of tuberculosis, farcy or glanders, the commissioner having condemned the animal infected therewith, shall cause such animal to be killed without an appraisal, but may pay the owner or any other person an equitable sum for the killing and burial thereof, and may also pay a reasonable sum for the animal destroyed should a post mortem examination prove that said animal was free from the disease for which it was condemned.

SECT. 4. Section seven of chapter fifty-eight of the Public Statutes is hereby repealed.

SECT. 5. This act shall take effect upon its passage.

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## APPENDIX B.

### COMMONWEALTH OF MASSACHUSETTS.

In the Year One Thousand Eight Hundred and Ninety-Three.

[CHAPTER 306.]

### AN ACT RELATIVE TO THE POWERS AND DUTIES OF THE BOARD OF CATTLE COMMISSIONERS.

*Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:*

SECTION 1. Each member of the board of cattle commissioners shall have all the power and authority conferred upon boards of health by sections one, two and three of chapter two hundred and fifty-two of the acts of the year eighteen hundred and eighty-seven, except the power and authority to make regulations in writing to regulate or prohibit the passage from, to or through any city or town, or from place to place within the same, of any cattle or other domestic animals, and all the power and authority conferred upon inspectors of provisions and animals under chapter fifty-eight of the Public Statutes: *provided*, *however*, that no appeal from any act done by any of said commissioners under said chapter fifty-eight shall lie to the board of health, as provided in section two of said chapter.

SECT. 2. When any member of the board of cattle commissioners, by an examination of a case of contagious disease among domestic animals, becomes satisfied that the public good requires it, he shall cause such animals to be securely isolated at the expense of the owner, or he shall cause them to be killed without appraisal or payment; but may pay the owner or any other person an equitable sum for the killing and burial thereof, and may also pay a reasonable sum for the animal destroyed, should it appear by a post mortem examination or otherwise that said animal was free from the disease for which it was condemned.

Sect. 3. Contagious diseases within the meaning of this act shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot and mouth disease, rinderpest, hog cholera and rabies.

Sect. 4. A person who fails to comply with a regulation made or order given by the board of cattle commissioners, or any of its members, in the discharge of his or their duty, shall be punished by a fine not exceeding five hundred dollars or by imprisonment not exceeding one year.

Sect. 5. Whenever the officers of a city or town refuse or neglect to carry into effect the provisions of section one of chapter fifty-eight of the Public Statutes as amended by section one of chapter one hundred and ninety-five of the acts of the year eighteen hundred and ninety-two and by section one of chapter four hundred and thirty-two of the acts of the year eighteen hundred and ninety-two, the commissioners shall have the power to appoint one or more persons to be such inspectors of provisions and of animals intended for slaughter or kept for the production of milk within said city or town. Such inspectors shall be sworn faithfully to discharge the duties of their office and shall receive such compensation not exceeding the sum of five hundred dollars a year each as the commissioners shall determine, such compensation to be paid by the city or town ; and such city or town shall be liable to forfeit a sum not exceeding five hundred dollars for such refusal or neglect.

Sect. 6. The mayor and aldermen of cities and the selectmen of towns shall have the power to remove any person appointed by them to be an inspector under section one of said chapter fifty-eight of the Public Statutes, as amended by section one of chapter one hundred and ninety-five of the acts of the year eighteen hundred and ninety-two and by section one of chapter four hundred and thirty-two of the acts of the year eighteen hundred and ninety-two, and the board of cattle commissioners shall have the power to remove any inspector appointed under said section whenever said inspector neglects or refuses to be sworn and properly perform the duties of said office, and in such case shall appoint another person in his place to serve for the balance of his term.

Sect. 7. The board of cattle commissioners may appoint a clerk to keep the records of their doings, who shall receive such compensation, not exceeding the sum of five hundred dollars a year, as they shall determine.

SECT. 8. Sections twelve and thirteen of chapter two hundred and fifty-two of the acts of the year eighteen hundred and eighty-seven, and section three of chapter one hundred and ninety-five of the acts of the year eighteen hundred and ninety-two are hereby repealed. [*Approved May 3, 1893.*

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## APPENDIX C.

# TUBERCULOSIS IN CATTLE.

By CHARLES P. LYMAN, F. R. C V. S.

[NOTE.—This paper is published solely as an answer to various inquiries coming to the Board from inspectors throughout the State; and, while an endeavor has been made to treat the several divisions of the subject in a way that may be clearly understood, it is proper to say, here, that it is not always easy to divest a purely scientific subject of all technicalities; although an attempt has been made to do so, as far as possible, in this instance. On the other hand, it is desired that the paper shall not be considered as being, in any way, an exhaustive treatment of the matter from a professional stand-point. No pretence to make it so has been made, as will readily be seen.]

It has been stated that consumption destroys one-sixth of the human race. Consumption and tuberculosis are one and the same disease. The same germ that produces tuberculosis in cattle produces consumption in man. The disease is communicable from a diseased man to a healthy animal, and from a diseased animal to a healthy human being.

The malady is conveyed from an affected animal to mankind through the milk or the meat used as food. It is because of this incontestible but rather recently appreciated fact that so much of an endeavor is now being made to rid the different States and countries of tuberculous cattle.

Among cattle the disorder is communicated by *contagion*, but in order that the contagion may be so communicated, an animal's body must be in a particular and peculiar condition of receptivity.

### CAUSES.

Just how this peculiar condition of body is produced we do not always know, but it seems that when an animal is constantly subjected to a system of treatment that demands a considerable amount of vital force for its accomplishment, she is by that act especially open to an attack of this contagion. Such treatment will include, among its most common operations, the frequent bearing of young, and the strong feeding which is undertaken to produce a large and long-continued flow of milk. This system is so largely followed by dairymen that the great wonder is that the disorder does not prevail to a greater extent among this class of animals than it does, in certain localities.

Another cause that will, after a while, create a decided condition of receptivity, is due to a badly managed in-and-in breeding, as a result of which some one noted and valuable trait, as an immense amount of beef or a tremendous flow of milk, is reproduced in the offspring, at the expense of the soundness of other organs of the body, with a sureness that is only equalled by the certainty with which disease shows itself in individual after individual of the race.

Another cause, and the greatest one of all, perhaps, is the breeding from animals which are themselves the victims of tuberculosis. This, in itself, is not apt to produce the disorder; but it does produce an animal that has an extremely strong "predisposition" to enter upon the state of receptivity; that is, to get into the peculiar condition which makes his body an exceedingly well-prepared and fertile *soil* for the implantation and growth of the *seed* (contagion) of tuberculosis. The fact that such animals are more open than are any others to an attack of this contagion is a further indication that there is something beyond a mere poor or "run out" condition necessary in its production; and that this "something" is reproduced in the breeding with as much certainty as are other more easily recognized and more valuable family peculiarities.

The contagion in this country, and in some others from which we import cattle is widespread and practically omnipresent. In order, therefore, that this danger to mankind may be reduced as much as possible, the supply that they are now receiving, through meat and milk, must be cut off by getting rid of our tuberculous cattle; and finally, by trying to produce a race of animals that will be proof against the contagion in as great a degree as certain families are now open to its ravages.

## Symptoms.

There is, in the first place, a certain but not always well-defined loss of activity; there will be *periods* in which the animal will seem dull and dejected; and many of these cows cannot be made to breed easily, while it is not at all uncommon for many of them to be almost continually in heat. The appetite is good, and the cow will fatten fairly or give a good yield of milk. With these cases there is very apt to be an occasional cough, dry, deep and feeble, that is especially shown, when there is, from any cause, any sudden change in the temperature, or when the barn is first opened in the morning. The cough is also particularly to be noticed when the animal exerts herself somewhat; and it is not at all a bad practice to run a suspected cow about for a few minutes to see if she will cough; if this is done immediately after she has been drinking water freely, it will be especially likely to produce the cough if the disease be present.

The symptoms of what may be called the secondary stage are emaciation, dull countenance, sluggish movements, skin dry and adhering more or less tightly to the ribs (hide-bound); the hair is dull looking, coat rough, and not infrequently feels damp to the hand. Slight exertion causes rapid breathing and cough, if the lungs are affected. The appetite is fickle or diminished; there may be constipation or diarrhœa, or the two conditions may alternate. The milk is somewhat diminished in quantity; the cough comes without apparent cause, or is easily induced by pressure upon the upper part of the windpipe. The breathing, rather increased in frequency, is sometimes accompanied by a little double expiratory effort, as if the animal stopped breathing for a second, and then finished expelling the remainder of the air from the lung before taking in the next breath.

In the third stage the cow is very thin and very much debilitated, the appetite is very fickle or almost lost, and there is more or less fever, which, however, is not evenly maintained through the twenty-four hours. The cough is very frequent, and the head is held on a line with the back, or lower. When the animal coughs the mouth is opened and the tongue protruded; the breathing is short and irregular. There is very often a diarrhœa, with a bad-smelling, dark-colored discharge.

A very excellent report upon the diseases of cattle has recently been published by the Bureau of Animal Industry of the Department of Agriculture in Washington, in which, upon page 405, appears a description of the symptoms of tuberculosis, taken from one of the Sanitary Orders issued in Switzerland; it is as follows: —

> A dry, short, interrupted, hoarse cough, which the sick animals manifest, especially in the morning at feeding time, still more after somewhat violent exertion. At first these animals may be full-blooded, and lay on a considerable amount of fat when well fed. As the disease progresses they grow thin, and show more and more those appearances which indicate diseased nutrition, such as a staring, lustreless, dishevelled coat; dirty, dense skin, which appears very pale in those regions free from hair. The temperature of the skin is below normal The loss of fat causes sinking of the eyes in their sockets They appear swimming in water, and their expression is weak. The cough is more frequent, but never or very rarely accompanied with discharge. The body con-

tinues to emaciate, even with plenty of food and a good appetite, so that the quantity of milk is small. At times, in the early stages of the disease, still more in the later stages, the diseased animals manifest considerable tenderness when pressure is applied to the front or the sides of the chest, by coughing, moaning, etc. Often all symptoms are wanting, in spite of the existence of the disease.

Although the endeavor has been made to point out the symptoms as plainly as possible, it should always be remembered that there are cases of tuberculosis in which the lungs are not affected, or are so little injured that the cough and irregular breathing will not be markedly shown; and there are others, coming rather under the head of the first sort described, in which the disorder has made so little impression upon the general system that its presence is recognized only with the greatest care, or is not recognized at all for weeks or even months after it has really obtained its foothold. As further aids in discovering the presence of the disease we may use a clinical thermometer and listen at (auscultate) the chest walls. The thermometer is to be looked upon as being simply an *aid* to diagnosis; it will not in any way declare whether or not the animal has tuberculosis.

Clinical thermometry is based upon the fact that *healthy* animals maintain an even internal temperature under certain varying circumstances. This temperature in cows, taken with a reliable instrument in the rectum, is 101° Fahrenheit. If it falls very much below this, say to 98° or 99°, and remains there for any length of time, the animal may be looked upon as being of a lowered vitality *for some reason or other*. If, on the other hand, the temperature is raised to 102.5° or more, and remains there for any length of time, it is a certain indication that there is fever *due to some cause or other*. I have found so many old chronic cases of tuberculosis in cows, when the animals have shown a very little dulness, and a considerable pallidity of skin and mucous membrane, and no other very marked symptoms, except after careful auscultation, in which the temperature has been as low as 98.5° or 99.5°, that I have come to look upon this low registry of the thermometer as being a sufficiently suspicious circumstance to induce a very careful examination of the animal in all cases wherein it is shown without apparent cause.

In some of the cases of the second, and in a large percentage of those of the third sort, as well as in some early cases, that except upon auscultation show no symptoms of tuberculosis whatever, the thermometer will be often found to register from 103° to 105°. This, unless the fact is otherwise clearly accounted for, will demand that a close examination of the chest be made; and still further that if, even then, no tuberculosis can be made out, *and no* *other cause of the fever ascertained*, the animal still be treated as suspicious, and removed from among others; for if the symptom is due to tuberculosis, the fever shown by the thermometer indicates that the disease is active; that there is a considerable change of tissue going on within the body, and the fair supposition is, that the disease is so much more aggressive at this time as to make the animal a particularly good disseminator of the contagious principle. The milk from animals of this sort should not be used.

### AUSCULTATION OF THE CHEST.

By this is meant a listening at the walls of the chest, that we may hear the noises that are made by the movements of the organs contained within it. This, by veterinary practitioners, is usually accomplished by pressing the ear firmly against the body at various points over the ribs; having the animal under examination in as quiet a place as possible.

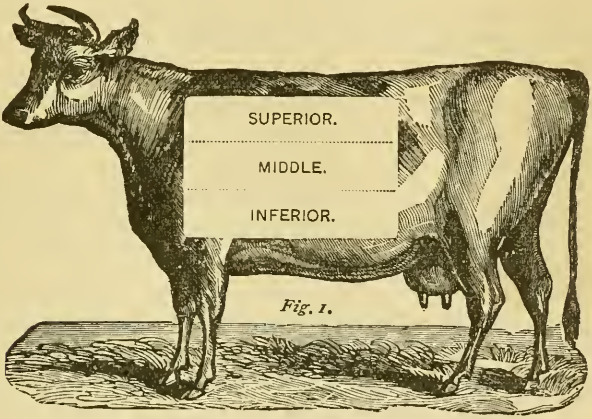


*Fig. 1.*

The sounds heard in a healthy lung are of two sorts; first those that are made by the air as it rushes through the air (bronchial) tubes, and called the *tubal sound*, which is a rough, blowing noise; and, second, the sound produced by the air as it enters and leaves the air sacs at the ends of the tubes, called the *respiratory murmur*, which is much softer and considerably less distinct than the sound first described. In order that the sounds produced in disease may be appreciated, it will be necessary first to become familiar with those that are to be heard in the healthy chest. For the purposes of this sort of an examination the chest is divided into three equal parts by drawing two imaginary lines across it from before backward. These divisions are called the superior, middle and inferior regions (Figure 1).

### SOUNDS IN HEALTH.

In the healthy animal, on the *right* side and in the *superior* region, a well-marked respiratory murmur is to be heard from just behind the shoulder to as far back as the tenth rib (cattle have thirteen ribs on a side) ; from here it decreases rapidly and is lost at the eleventh rib. In the *middle* region there is a loud, rude, respiratory murmur heard over the fourth, fifth, sixth and seventh ribs ; this decreases gradually from the seventh and is lost over the tenth or eleventh. In the *inferior* region the sound is tubal over the fourth and fifth ribs. From the sixth to the ninth there is a respiratory murmur, which has a gradually decreasing force as the examination extends backwards.

In the healthy animal on the *left* side and in the *superior* region the sounds of the right side are repeated. In the *middle* region the sound is more feeble over the fourth, fifth and sixth ribs than it is on the right side. In the inferior region, there is a feeble respiratory murmur over the fourth rib ; this grows louder over the fifth and sixth ribs and then decreases as far as the eighth or ninth, where it is lost.

Then there are sounds which, although they are often heard, must not be confounded with sounds coming from within the *chest;* these are : on the *right* side, in the *superior* and *middle* regions, posteriorly, a rumbling which is produced by the movements of the portions of the small intestine which is there located.

On both sides, but strongest in the left, in the *inferior* region and behind the eighth rib, a crackling sound is to be heard, which comes from the paunch, and is due to a certain process in the digestion of the food. It is best heard shortly after the animal has eaten, more especially when the fodder has been green. In this same region a strong rubbing or creaking sound is oftentimes heard ; this also comes from the paunch, and is due to its movements, accompanying the digestion of food. It is more commonly heard while the animal is chewing the cud.

Lastly, on the *left* side and in the *posterior* part of the *inferior* region, there is at times a gurgling sound, which is due to the movements of liquids within the stomachs.

All of these sounds may be easily separated from those coming from within the chest by remembering that they occur at *irregular* intervals, and have no connection whatever with the breathing movements of the chest walls ; and that sounds coming from the lungs are produced *regularly*, and always occur *with* one or other of the breathing movements.

## ABNORMAL SOUNDS.

The sounds indicating a changed or diseased condition of the lung depend upon the character of the change giving rise to them; and, inasmuch as several of the changes may exist in one and the same lung, the sounds are oftentimes complicated in the extreme. For the purposes of this paper it will be quite sufficient, however, if I name the typical sounds, and describe the conditions usually giving rise to them.

The respiratory murmur may be increased or diminished in pitch, or it may be entirely absent.

## ON INCREASED SOUNDS.

When the breathing sounds are louder than natural in both lungs, unless the animal has been recently exercised or excited, it is due to high fever, such as may accompany a great variety of ills, *certain cases of tuberculosis included.* When the sound is increased in one lung alone, or in different parts of one or both lungs, it invariably indicates that there is some other part of one or both lungs that *for some reasons* is not receiving its proper share of air. *The louder noise is made because of the greater amount of work put upon those parts of the lung which remain sound.*

This condition will be found accompanying different diseases; and in those cases of tuberculosis in which there is a complication of pneumonia (lung fever), as well as in those which have been the subject of large deposits of the peculiar matters accompanying certain of the cases, it is a symptom of great value.

When there is a loud, rude, respiratory, almost tubal sound in those parts of the chest in which it is not natural, it indicates that there the lung, or a portion of it, has, *for some reason*, become more solid, and therefore a better conductor of sound. The coarse sounds heard are brought from the large bronchial tubes at the "root" of the lung, through the abnormally solid lung tissue, to the ear. This condition is found in pneumonia, and in those cases of tuberculosis in which there are large solid accumulations or deposits. It is a symptom of value.

## ON DIMINISHED SOUNDS.

Diminution of respiratory murmur may be heard in one or both lungs. When in one lung only it is a much more suspicious circumstance, so far as the probable existence of tuberculosis is concerned, than if it is noticed in both to an equal degree. It can be looked upon in this connection as simply indicating that, *for some reason or other*, tuberculosis *perhaps*, the respiratory power of the lung is interfered with.

So many of the causes of double suppression (diminution of the murmur in both lungs) are entirely unassociated with the chest that, for our present purpose, it becomes a symptom of no value whatever, although upon some occasions it is associated with the disease under consideration.

### On Absence of Respiratory Murmur.

Complete absence of the respiratory sounds in one lung, or in portions of both lungs, exists in connection with cases of lung fever, dropsy of the chest and tuberculosis. In the latter case the entire absence of sound in the part will be due to a consolidation of the lung tissue, when pneumonia is in complication with the tuberculosis; or else to large deposits of the purulent or cheesy tuberculous matters. A description of the further modification of these sounds, the detection of cavities, etc., are entirely too intricate for the present purpose.

### Râles.

In addition to the abnormal sounds already described, which are really no more than modifications of the natural sounds, there are another series which are essentially distinct from the sounds of health, and which are called râles or rattles. Very shortly stated, these sounds are of two sorts: a dry râle, which is a more or less wheezing or musical note produced by an abnormal narrowing of a bronchial tube; a sound that is coarse or fine, depending upon the size of the tube in which it is produced; and a *moist* râle, produced by the passage of air over or through mucous or other fluid contained in the tubes. This râle is also coarse or fine.

Both of these sounds, as well as their many complications and divisions, will arise from any disease of the lung in which the bronchial tubes become implicated; and, inasmuch as these tubes are implicated in a large number of the cases of tuberculosis of the lungs, some or all of these notes are very frequently to be heard in one or another part of the chest of the affected animal. Sometimes they will be found to extend over a large area, and will be easily heard; at other times so small a portion of the lung will be changed that the sound will only be discovered after a most careful examination. When it is discovered, unless its presence can otherwise be clearly accounted for, the animal should be looked upon with great suspicion.

All sounds, normal and abnormal, are very much more difficult to hear in fat animals, or in those having round chests; and in all cases the lung sounds will be very much easier to hear if the animal is driven about actively for a few minutes just previous to the examination. All *lung* sounds are made either during inspiration or expiration of the breath; never during either of the intervals.

## DIAGNOSIS.

To give such special directions as are possible, that will point out clearly and distinctly the presence of tuberculosis, will be but to repeat what has already been said while speaking of the symptoms.

It is a well-known fact that there are many instances in which active, healthy-looking, fat cattle, after having been butchered for their beef, are found to show limited, but nevertheless strongly-marked effects of the disorder in their lungs, livers, bowels, etc. These animals, *so far as can be ascertained*, have never shown any symptoms of disease whatever and certainly it would be difficult to find finer or healthier looking cattle than many of them are at the time they are slaughtered. *If an animal shows no symptoms whatever of being diseased it certainly will be impossible to lay down any rules that will detect disease in him.*

On the other hand there are many cows that cough frequently, have a rough, unthrifty looking coat of hair, are thin in flesh, and have perhaps, in addition, some one or more of the other symptoms of tuberculosis, which, upon examination of the chest, show no symptoms of disease of the lung, and which upon being killed and carefully examined present no evidence whatever of tuberculosis. In these instances, unless we place sole reliance upon the symptoms furnished by a physical examination of the chest, we shall kill many animals as tuberculous *which a post-mortem examination will show to be free from the disorder.*

As has already been pointed out, there are a line of cases, and they are very far from being infrequent, in which, with the other general symptoms, râles are present in the bronchial tubes. Such an animal being examined at one time may show these plentifully; the same animal examined again will show no evidence whatever of a râle either at the spot where the sound was formerly heard or at any other part of either lung. We must always remember that moist râles or rattles are due to the presence of more or less fluid in the bronchial tubes; and that while this fluid may be due to the effects of tuberculosis, it may also be due to bronchitis, local or general, from some *other* cause; or that even there may be a rattle of a transitory sort that is not due to any appreciable diseased condition. Therefore, if we allow ourselves to destroy an animal upon this symptom, without first having taken care to see that the râle is *persistently* shown in the same place, we shall often destroy one that the post-mortem examination will show to have been free from the disorder; and even with this precaution we shall occasionally kill an animal that has chronic bronchitis, but no tuberculosis.

*Temperature.* — There is no doubt whatever that in certain cases of tuberculosis the thermometer is a very great aid to diagnosis; and, just as truly, there are many instances in which it fails to give anything more than an absolutely negative indication. If among a herd of cows there is an animal in which the thermometer shows a rise to 102.5° or 103°, she should at once be treated as a "suspect," unless good and sufficient reasons for the rise can be found, and put by herself to await further developments. If, then, after a time, the fever as shown by the thermometer should persist, and other symptoms of tuberculosis appear, the thermometer, in the instance, would have been a good and early indication of the presence of the tubercular poison in the animal. A thermometer will not declare whether or not a certain fever is due to tuberculosis; but it will point out, without failure, whether or not there is a rapid change of tissue going on within the animal; and this change is a marked feature of tuberculosis, as well as of many other acute diseases.

Then, again, in certain herds of cows, where the average temperature of the herd will be about 101°, it will be noticed that there are one or more animals that show a temperature of about 99° only. Such animals, upon careful examination of the chest, often show symptoms of tuberculosis; and a post-mortem examination shows the disorder to have been of considerable standing, its products being in a low, degenerated condition, and of extent enough to have greatly lowered the vitality of the animal and rendered her anæmic. In these instances the thermometer is valuable in indicating, in the first place, that the animal is, for some reason or other, in a depressed condition, which, if it cannot otherwise be satisfactorily accounted for, should lead to a careful examination of the chest.

There is no doubt whatever that, in diseased animals especially, the temperature will be higher at certain times of day than at others; also that these periods will vary, depending upon the nature and stage and age of the tuberculosis. But it may be distinctly stated, as a rule, that when tuberculosis is very progressive or active it is accompanied by a continuously high temperature; and that when it is inactive or simply degenerative, it is accompanied by a continuously low, that is, a normal temperature; or, upon frequent occasions, as already pointed out, by one which may be as low as 98°.

*Cough.* — This symptom has popularly been supposed to be one of great value in connection with the diagnosis. The cough in the earlier stages is a dry one, occurs in paroxysms, and is due to an irritation of the lining membrane of the bronchial tubes, which is often one of the first effects of the tubercular poison. Because of this peculiarly irritable condition the respiratory tubes are quite susceptible to slight changes of atmosphere; therefore when a cow of this sort is moved from a warm place to a cold one, or *vice versa*, she is much more apt to cough than not; as she is, for the same reason, when made to take exertion of almost any sort in a sufficient degree to cause the slightest increase in the respiratory effort. In the later stages the cough becomes moist because it depends upon the existence of a real bronchitis of greater or less extent. If this bronchitis is extensive the cough will be frequent, distressing, and will take place after the slightest exertion or, at intervals, without exertion. It must be remembered, however, that unless there is irritation or inflammation of the respiratory tube, with the tuberculosis, there will be no cough; and while there are a great many cases of tuberculosis in cows that do not cough at all attractively, there are also many cows that do cough considerably that have no tuberculosis. Cows are like men in that they cough from many causes quite aside from tuberculosis; and if the cough comes from irritation of the same parts of the tubes, to the same extent, *from any cause*, it will have about the same sound and occur under the same circumstances.

### CHANGES, CAUSED BY THE DISEASE, FOUND AFTER DEATH.

As has been said, it is now an accepted fact that by the term tuberculosis is meant a diseased condition brought about by the entrance of a specific germ into the body of a susceptible living animal. This germ is technically called a *tubercle-bacillus* and can be seen with a high-power microscope.

*Tubercle-bacilli* having gained entrance may be carried to various parts of the body by the circulating blood; by the circulation in the lymphatic system; by building upon themselves, as when they have gained previous lodgment on *the surface* of a membrane; or by transplantation, as when phlegm from a diseased portion of lung is coughed up, and before being expectorated falls into another portion of lung, or is swallowed.

Tuberculosis may be local or general; *local*, when it is limited to the organ or tissue that was first invaded, and which it gradually but ultimately destroys; *general*, when large numbers of the bacilli have gained simultaneous lodgment, by having been widely scattered by the blood current, and have then, by being upon soil peculiarly adapted to their growth, sprung up in large numbers.

In whatever way the bacilli are brought to any portion of the body and obtain development, one of their early effects is to produce, in that part, a number of small round bodies called nodules, that are quite visible to the unaided eye, and which so invade the texture of the affected organ or tissue as to quite change its appearance. These changes and their consequences, in their various degrees, constitute what are known as the anatomical characteristics of the disorder; that is, the *post-mortem* appearances.

As has just been shown, the disease may become seated in any portion of the body, but it is very much more commonly met with, in cattle, in the lungs and other organs within the cavity of the chest. Other locations are upon the organs within the abdominal cavity; about the joints, especially the stifles or hocks, perhaps; in the udder; and in the serous membrane covering of the brain.

When the tubercle is young its color is a grayish white, and it is semi-transparent; a little later it becomes yellowish and opaque. A single tubercle may be no larger than a number six shot, or it may reach the size of a small pea, and has a rather roundish form. Tubercles very much more commonly exist in masses of a dense, hard tissue, with a nodulated surface that is not at all easily separated from the surrounding parts.

As the tubercles grow older they commence to degenerate and their appearance and character change considerably. Among these changes is that known as "calcification," in which each nodule becomes hard and feels like a little stone. When cut into it grates under the knife, and the cut surface looks like particles of yellow, greasy chalk, held together by fine bands of gristle.

Another very common change is that one called "softening;" this may or may not follow calcification. This commences at the centre of the nodule, or the mass of them, and from there extends towards the outer edge until the whole of the new growth has been changed into the peculiar soft, so-called "cheesy" material. This cheesy deposit varies a little in color and consistency under different circumstances. It may be grayish yellow and rather soft, or a whiter yellow and harder. This depends upon whether or not calcification has preceded it. As these masses grow older there will often be centres of softening at various points within them, forming cavities of greater or less extent, which contain purulent matter. In the lungs and some of the glands, masses often assume tremendous proportions.

Another form of the tubercular deposit that is far from uncommon in cattle is that in which the new growth springs up from the serous membrane, lining the walls of the chest, and covering the lungs themselves (the pleura); and from that lining the cavity of the abdomen (the peritoneum). These masses assume the most various shapes; there may be a patch of round, berry-like growths covering a considerable space on the *surface* of the membrane; or the same growth may hang down into the cavity, having something like a rude resemblance to a bunch of grapes. They are yellowish or blueish white in color; glistening and hard to the touch, not unlike gristle, and vary in size from that of a pea to perhaps as large as a crab-apple. To this appearance of tuberculosis the Germans have given the name of *pearl sickness;* the French *angle-berries.* In England it is known as "*the grapes.*"

Tubercles are also frequently discovered in the liver, kidneys and some other of the organs; but in these situations they are never numerous, nor do they exist in large masses. As pointed out while describing the symptoms, the great irritation caused in the lung by the presence there of the tubercular growth oftentimes sets up pneumonia, that is, an inflammation of the substance of the lungs; or bronchitis, that is, an inflammation of the lining membrane of the bronchical tubes; in which cases the *post-mortem* appearances will show the effects of one or other or both of these conditions, in addition to those of the tuberculosis proper.

In the volume published by the Department of Agriculture, already referred to, on page 404, it is stated: "As regards the frequency of the tubercular processes in the different organs, the following carefully compiled statistics of the disease in Bavaria and Baden may serve as a guide": —

| | Per Cent. |
|---|---|
| Bavaria: — | |
| Tuberculosis of lungs and serous membranes, | 41 |
| Tuberculosis of lungs alone, | 33 |
| Tuberculosis of serous membranes alone (pearly disease), | 17 |
| Tuberculosis of other organs, | 8 |
| Baden: — | |
| Tuberculosis of lungs alone, | 21 |
| Tuberculosis of serous membranes alone, | 28 |
| Both combined, | 39 (?) |
| Generalized tuberculosis, | 9 |
| Tuberculosis of the sexual organs alone, | 3 |

### TREATMENT.

Any discussion of the medical treatment of *cattle* suffering from tuberculosis (consumption) is entirely out of the question. Such animals should be killed as soon as possible, and the carcasses safely disposed of by deep burial; or, better still, rendered into fertilizer by exposure to extreme heat; or burned with fire. So that, for us, the whole question of treatment comes to a consideration of the measures to be undertaken for its suppression; and this, in its turn, comes to a discussion of the best means of overcoming the causes.

The causes are, to repeat shortly, a peculiar condition of body, and the presence of the contagious principle.

We have found that, so far as we know, this peculiar condition of body is most readily brought about by breeding from animals that are themselves diseased, or from those belonging to families that are known to have been consumptive in the past. Closely following this is a system of ill-judged in-and-in breeding, the frequent bearing of young, and the great and continued production of milk.

Other causes are those that may be put under the head of bad sanitation, which includes the feeding of rich grains in too great quantities; of food that, while it may be sufficient in bulk, is still of such poor quality that it cannot furnish sufficient nourishment; overcrowding animals in the stable; housing them where the air is not sufficiently pure, or where they are exposed to cold draughts; and in allowing them insufficient exercise.

The remedy in each of these cases is clear, and may be easily applied.

To get rid of the contagious principle is by no means such a simple matter; and it can never be accomplished except as a result of concerted action. It is because of this fact that the suppression of tuberculosis has been so generally undertaken by the various governments all over the world; and measures have been put into the form of laws; and officers have been appointed to execute them.

In the application of these laws it is always well to remember that the nature of this particular contagious principle is such that it by no means follows because tuberculosis is discovered to exist in one animal of a herd there must necessarily be others there that are diseased. It will not therefore be within reason to condemn and destroy entire herds, or even to condemn the milk from them; the process of elimination must, necessarily, be a slow one; and will consist nearly always in an intelligent, systematic, repeated and long-continued "weeding out" process, if the term may be used in this connection.

Second cases, in a herd, should always be carefully looked for, and will be more likely to be found among those related to the discovered case.

In certain rare instances, wherein the disorder persists unaccountably after repeated careful examinations of the animals and their surroundings, together with the destruction of those that have been discovered, all had better be fattened and slaughtered as soon as possible; those carcasses that prove to be healthy used for food, the others destroyed. No new animals should be put with any of the old herd, or even into the same stable, until the *cause* of the great persistency has been satisfactorily explained.

The detail of the laws of the different governments regarding the suppression of tuberculosis differs very materially; but of all these methods that law will be the most effective that subjects *all* of the cattle to a regularly repeated and intelligent examination; that most surely prevents animals known to be diseased from being sold or hidden by their owners, or dressed for beef by unprincipled butchers; that makes it possible to destroy them with the least delay after they are found; and that divides the expense of doing the work and the loss of the animals with the greatest fairness between those who are the most directly benefited, namely, the owner, the town and the Commonwealth.

# THIRD ANNUAL REPORT

OF THE

# DAIRY BUREAU

OF THE

# MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED

UNDER CHAPTER 412, ACTS OF 1891.

JANUARY 15, 1894.

# REPORT OF THE DAIRY BUREAU.

*To the Senate and House of Representatives of the Commonwealth of Massachusetts.*

The past year was the second complete year of the existence of the Dairy Bureau; and its labors have been continued along the general lines reported a year ago, with such increased efficiency as would result from increased experience. The *personnel* of the Bureau and its executive staff has been unchanged; the governor reappointed the retiring member, Mr. Clemence, and also the working executive officer, Mr. Whitaker; the Bureau has continued the services of Mr. Stockwell in the detective and court departments. Hence the work has received the full advantage not only of accumulating experience, but also of the concerted action of those becoming more and more accustomed to labor together.

As we advance in the work and more fully realize its possibilities, the meagreness of the appropriation becomes more apparent. The Bureau is given both educational and police duties, covering the whole State, with an appropriation less than one-half of what the city of Boston places at the disposal of its milk inspector for only police work. This small sum restricts us to one detective agent, where the Boston milk inspector has four or five, and it also limits our expenditures for expert assistance in the educational field. As the dairy laws of the State relate more to commercial frauds than to the public health, possibly at some time our funds may be increased, and by friendly arrangement with the Board of Health our field of operations may be enlarged without encroaching on theirs. They could then be relieved of the compulsion of expending three-fifths of their appropriation on dairy products, and could be unhampered in the field of health work; while we, in harmony with them, would have the dairy laws under our more especial charge, with particular reference to commercial frauds.

The educational work of the past year has consisted in studying the problems peculiar to both the consuming and producing dairy interests of this State. It has sixty-three cities and towns of over five thousand population, with a million and a half people to be supplied with fresh and pure milk each day; thirty co-operative creameries and five proprietary creameries; a cow population of 186,806 animals and the commercial centre of New England in its midst; within a radius of twelve miles is a population of three-quarters of a million people. In connection with this educational work thirty meetings have been addressed, bulletins have been issued, fourteen creamery inspections have been made, and a butter exhibition has been held. Much has been done to acquaint milk producers and milk consumers with the varying qualities of milk, and the easy, ready method of investigating them by the Babcock milk tester,— a modern invention of untold importance, which will revolutionize many practices.

The police work has been mostly confined to an enforcement of the oleomargarine laws. The appropriation precludes attention to both the milk and oleomargarine laws; and, as the Board of Health does more with the former, we attend to the latter. Our work has been largely outside of Boston. In this city the laws are so well executed by Dr. Harrington, milk inspector, that it would be a waste of effort to attempt much in this field.

The following is a more detailed report of our work.

## Co-operation with the Boston Milk Inspector.

Section 3, chapter 58, Acts of 1891, and section 2, chapter 310, Acts of 1884, give inspectors of milk authority to enter all places where butter or imitations thereof are kept for sale, and to take samples. These statutes say nothing about the deputies or agents of milk inspectors, and attorneys have questioned the authority of these agents. The law creating the Dairy Bureau gives all needed power "to such agents, and counsel as they shall duly authorize." Therefore, Dr. Harrington, the Boston milk inspector, and all his deputies and collectors, have been made agents of the Dairy Bureau. This has also helped them in enforcing the milk laws, as, being State officers, they can, to catch a lawbreaker, follow an offending milk peddler beyond the city lines, if necessary.

## The Anti-color Law.

Our work in enforcing the oleomargarine laws has been curtailed by proceedings in the higher courts relative to the constitutionality of chapter 58, Acts of 1891. This is the law which prohibits the sale of any imitation of yellow butter, and which our State supreme court has once declared constitutional. To the oleomargarine interest this law is the most obnoxious of all the statutes relative to imitation butter, and is fought by them with the utmost persistency. As soon as the decision of the supreme court was rendered, the enforcement of the law was entered upon. An appeal was taken from this State decision to the United States supreme court, and it was contended that this act rendered the State law inoperative, pending the decision at Washington. But, as those entrusted with the enforcement of the law held an opposite view, an attempt was made to secure an injunction in the United States circuit court, to restrain the Boston milk inspector from acting under this statute. Attorney-General Pillsbury appeared for the Commonwealth, arguing that such interference by a circuit court of the United States is forbidden by the constitution and the laws of the United States.

The petition for an injunction was never granted; but, as a new appeal was taken to the State supreme court, the status of the law continued in such doubt that no cases have been brought under it for several months. In the case now before the State supreme court the defendants raised seventeen points on which they wished the judge to rule and instruct the jury. The judge refused, but did rule on three other points, to all of which exception was taken.

## Detective and Court Work.

In spite of the principal law being "tied up," much work has been done, which may be statistically summarized as follows: —

| | |
|---|---|
| Stores inspected, | 382 |
| Samples taken, | 113 |
| Cases entered in court, | 48 |

The result of these forty-eight cases has been as follows: —

| | | |
|---|---|---|
| Convictions, | 23 | |
| Plead guilty, | 7 | |
| | — | 30 |
| Acquitted, | | 12 |
| Not prosecuted, | | 6 |
| | | 48 |

Of the above six, three were withdrawn on account of informality in complaint or lack of evidence, and three in order to secure a plea of guilty in other cases. In one instance, having five cases against one person (a young lady), we consented to *nol pros* two in consideration of a plea of guilty being entered in the remaining three. Six of the acquittals were in cases where oleo was sold when butter was called for, because the statute omits to include "by himself or agents" in the prohibition; and the courts decided — on the basis of an intoxicating liquor decision — that, in view of this decision, the statute omitting "by himself or agents," the principal was not holden for the acts of the agent who acted contrary to orders. The person who actually makes the sale is now complained of.

The cases in court were under the following complaints: —

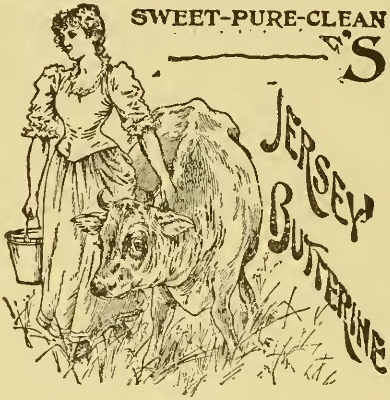
| | |
|---|---|
| No sign in store, | 3 |
| Hotel and restaurant, | 6 |
| Selling imitation of yellow butter, | 6 |
| No mark on wrapper, | 13 |
| Selling oleo when butter was called for, | 20 |
| | 48 |

This department of the Dairy Bureau's work has been more beneficial and restraining than a mere list of court cases would signify. The prevention of crime is as important as the punishment of lawbreakers. The occasional unexpected visits of an agent of the Dairy Bureau in the various parts of the State has, we believe, deterred many would-be lawbreakers, and promoted honesty in the sale of oleomargarine. Although much is still sold in the State, especially since the system of selling on orders was devised, our labors have done much to increase honest dealings and to curb fraud.

### NEED OF LEGISLATION.

That forty-two per cent of the cases, almost one-half, were for absolute fraud, is significant.

As regards the need of these laws, the experience of another year only confirms and emphasizes what we said a year ago. While the oleomargarine manufacturers claim to have discovered a new food product of great value to the public, "a separate and distinct food product," "a distinct and valuable food product, which sells on its own merits," the way in which it is too often sold at retail has a strong flavor of deceit and misrepresentation. The following is a photographic reproduction of the trade mark of one manufacturer, — omitting his name. It is not suggestive of an independent food product, selling on its intrinsic individuality.



"The largest butter store in Boston. Try our fancy Jersey Butterine Prints," was a sign recently displayed on Blackstone Street in this city, urging people to buy that "independent and separate food product, sold on its intrinsic merits." Butter tubs, butter color, dairy nomenclature, prominent butter signs, opposition to all laws for honest wrappers and marks, are familiar features in the history of this independent and separate food product, sold on its intrinsic merits.

We reproduce below the market quotations of oleomargarine in the style in which they appear daily in the Chicago papers. This also does not appear like an individual independent food product, like cheese or eggs.

> **THE PRODUCE MARKET.**
>
> BUTTER—Firm. Receipts. 395,011 lbs; shipments, 511,100 lbs. Fancy creamery, 28½@29c per lb; fine, 27@28c; fair to good, 23@25c; choice to fancy cooleys, 24@26c; choice dairies, 22@24c; fair to good, 17@20c; ladles. No. 1, 18c: No. 2. 16½@17c; packing stock, 16@17c.
>
> BUTTERINE—Steady. Fancy creamery, 19c per lb. Illinois creamery and extra dairy, 17c; Empire and Diamond dairy. 16c; Eastlake and Lakeside dairy, 14½c. Rolls, prints and 10-lb pkgs. ½c per lb additional.
>
> CHEESE—Receipts, 298.284 lbs: shipments, 340.850 lbs. Firm. Full cream. choice, 10@11c per lb; twins, sharp. 7@9c; Young Americas. 7@11c: sour and out of condition, 4@6c; brick, 10@11c; Limburger, 10½@11c: Swiss, 10½@11½c.
>
> CALIFORNIA FRUITS — Offerings liberal. Peaches, 20-lb boxes 80c@$1 15; pears, 40-lb boxes. $2@3.50: grapes, $1.40@1.60 per ½ case.
>
> EGGS—Receipts. 4.028 pkgs: shipments, 3.903 pkgs. Firm. Fresh northern, 20c per doz.

We are not opposed to any valuable food product which is or may be put upon the market "in a separate and distinct form, and in such manner as will advise the consumer of its real character." We repeat what we said last year: —

"We are not prepared to dispute the statements of honest scientists in relation to the value of oleomargarine; we are ready to admit that there is a theoretical oleo, which, if put upon the market honestly, on its merits as an independent article, might have proved an important addition to the world's food products. But the ordinary commercial oleomargarine with which we have to deal seems in many cases to exert a benumbing influence on the moral sensibilities of those who handle it."

In the above we do not overlook the fact that there are degrees of digestibility, and that butter is superior to oleomargarine on this score.

At Chicago, Armour & Co. displayed a bulletin announcing Massachusetts as one of the States where its sale is prohibited; and yet it is claimed that the receipts of oleomargarine in Boston for the year were 228,554 packages, against 188,380 packages in 1892, — an increase of 40,174 packages. Armour & Co. also made this assertion: "The United States has approved of its sale by its acts of inspection, regulation and taxation." Thus they perverted an act aimed against them into an endorsement of their goods.

## Needed Amendments to Laws.

The experience of the past year has shown where several amendments might add to the efficiency of the laws. Add the words in italics in the first four paragraphs: —

Chapter 412, Acts of 1891, section 1. Whoever *by himself or agents* sells or offers for sale, etc.

Chapter 412, Acts of 1891, section 2. Whoever exposes for sale oleomargarine, butterine or any substance made in imitation or semblance of pure butter, not marked and distinguished by all the marks, words and stamps required by existing laws, and not having in addition thereto upon *the exposed contents of* every opened tub, package or parcel thereof a *conspicuous* placard with the word "oleomargarine" printed thereon in plain uncondensed, etc.

Chapter 58, Acts of 1891, section 1. No person, by himself or his agents or servants, shall render or manufacture, sell, offer for sale, expose for sale, *take orders for the future delivery of*, or have in his possession with intent to sell, any article, product, or compound made wholly or partly out of any fat, oil or oleaginous substance or compound thereof, not produced from unadulterated, etc.

Chapter 317, Acts of 1886, section 3. Whoever, by himself or his agents, sells, exposes for sale, or has in his possession with intent to sell, any article, substance or compound, made in imitation or semblance of butter or as a substitute for butter, and not made exclusively and wholly of milk or cream, or containing any fats, oils or grease not produced from milk or cream, contained in any box, tub, article or package, marked or labelled with the word, — dairy, — or the word, — creamery, — *or the name of any breed of dairy cattle*, — shall for every such offence forfeit to the city or town where the offence was committed one hundred dollars, and for a second and each subsequent offence two hundred dollars.

Also prohibit the use of the word dairy, or creamery, or the name of any breed of cattle on any sign, placard or advertisement.

Add to section 9, chapter 412, Acts of 1891, "Whoever hinders, obstructs, or in any way interferes with an officer or duly authorized agent of the Dairy Bureau in the performance of his duty shall be punished by a fine of fifty dollars for the first offence and of one hundred dollars for each subsequent offence."

Section 4, chapter 412, Acts of 1891, which provides for a placard upon the wagon of "whoever peddles, sells or delivers from any cart, wagon or other vehicle, upon the the public streets or ways, oleomargarine, etc.," should be amended by striking out the words "upon the public streets or ways."

The municipal license fee should be increased from fifty cents to not over twenty-five dollars.

## Butter Exhibition.

A successful butter exhibition was held by the Dairy Bureau in connection with the winter meeting of the Board of Agriculture at Great Barrington. Every butter maker in the State was invited to contribute to the exhibition; no prizes were awarded, but all the specimens were examined and scored by experts, — Mr. E. A. Harris of Hovey & Co., Boston, who was one of the three judges at the World's Fair at Chicago, and Mr. James Cheesman, the well-known dairy expert. The exhibits were all made by number, and in order to increase the educational value of the exhibition, the judges were requested to use the utmost frankness in criticising. These criticisms were entered on the score cards, — the anonymous features being maintained, — and the public was invited to test the specimens and catechise the judges.

The entries included: —

| | |
|---|---|
| Creameries, | 12 |
| Private dairies, | 49 |
| Unsalted samples, | 2 |
| Granular samples, | 4 |
| | 67 |

The season was not propitious for high scores. It was so near the border line between fall and winter that many of the specimens showed wintery imperfections, effects of frosty feed, milk of strippers, or other defects incident to the cattle not being fully settled on a winter basis of food and other conditions.

On the point of flavor (45 being perfect): —

| | |
|---|---|
| 40 was scored by | 1 |
| 39 was scored by | 2 |
| 38 was scored by | 6 |
| 37 was scored by | 2 |
| 36 was scored by | 8 |
| 35 was scored by | 8 |
| 34 was scored by | 7 |
| 33 was scored by | 8 |
| 32 was scored by | 8 |
| 31 was scored by | 4 |
| 30 and below was scored by | 9 |
| | 63 |

Twenty-five were perfect as to "grain," and thirty-eight were cut from one-half to five points.

Nineteen were perfect in color, and forty-four were cut from one-half to five points.

Only thirteen were imperfect in salt.

Thirty-two were perfect as to package.

After the exhibition, most of the samples were analyzed. The water content ranged from 7.20 to 15.80 per cent.

| | |
|---|---|
| 6 samples had below | 9 per cent of moisture. |
| 8 samples had between | 9 and 10 per cent of moisture. |
| 17 samples had between | 10 and 11 per cent of moisture. |
| 13 samples had between | 11 and 12 per cent of moisture. |
| 8 samples had | 12 per cent or over of moisture. |

The amount of salt ranged from 1.40 to 6.95 per cent.

The amount of casein ranged from .49 to 8.24. The sample having the extraordinary amount of 8.24 per cent of casein was terribly rancid. Thirty-six of the fifty-two samples had less than 1 per cent of casein.

The amount of butter fat in the samples analyzed ranged from 79 per cent to 88.90.

| | |
|---|---|
| 3 samples had from | 79 to 80 per cent. |
| 2 samples had from | 80 to 81 per cent. |
| 1 sample had | 81.40 per cent. |
| 6 samples had from | 82 to 83 per cent. |
| 5 samples had from | 83 to 84 per cent. |
| 6 samples had from | 84 to 85 per cent. |
| 10 samples had from | 85 to 86 per cent. |
| 8 samples had from | 86 to 87 per cent. |
| 8 samples had from | 87 to 88 per cent. |
| 3 samples had | 88 per cent and above. |
| 52 | |

## TESTS OF MILK AND CREAM.

During the year three hundred and six samples of whole milk, cream, buttermilk and skim-milk have been tested for the amount of butter fat they contained, using the Babcock milk tester. Many of these tests have been made at public meetings, as an object lesson on the varying quality of milk. The following is the result from testing the milk of individual cows: —

| Per Cent of Fat. | Per Cent of the Tests. |
|---|---|
| 1.80 | 1 |
| 2.40 | 2 |
| 2.60 | 1 |
| 2.80 | 0.5 |
| 3.00 | 2 |
| 3.20 to 3.40 | 4 |
| 3.40 to 3.60 | 9 |
| 3.60 to 3.80 | 7 |
| 3.80 to 4.00 | 10 |
| 4.00 to 4.20 | 9 |
| 4.20 to 4.40 | 7 |
| 4.40 to 4.60 | 6 |
| 4.60 to 4.80 | 6 |
| 4.80 to 5.00 | 10 |
| 5.00 to 5.20 | 6 |
| 5.20 to 5.40 | 3 |
| 5.40 to 5.60 | 2 |
| 5.60 to 5.80 | 2 |
| 5.80 to 6.00 | 1 |
| 6.00 | 0.5 |
| 6.20 | 4 |
| 6.40 | 1 |
| 6.60 | 1 |
| 6.80 | 2 |
| 7.60 | 2 |
| 7.80 | 5 |
| 8.20 | 5 |
|  | 100 |

Tests of herd milk resulted as follows: —

| Per cent of Fat. | Per Cent of the Tests. |
|---|---|
| 2.80 | 3 |
| 3.20 | 3 |
| 3.40 | 3 |
| 3.60 | 6 |
| 3.80 | 12 |
| 4.00 | 11 |
| 4.20 | 6 |
| 4.40 | 20 |
| 4.60 | 10 |
| 4.80 | 10 |
| 5.20 | 10 |
| 5.80 | 6 |
|  | 100 |

Cases where the milk was known to be abnormal have been omitted from the above tabulation. For instance, one sample tested 8.40 per cent of fat, which proved to be the milk of a high-grade Jersey which had been milked a year, and was giving only two and a half quarts per day. Tests have been made of the same milk under different conditions which are not included in the above tabulation: milk from the top of a can which had been standing less than half an hour tested 4.20 per cent, and from the bottom of the can 4 per cent;

from a can which had been standing four hours, milk from the top tested 5.40 per cent of fat and from the bottom 4.80. The bottom of a can from which the top had been poured as needed for domestic use tested only 1.60 per cent of fat. Several specimens of strippings tested from 8.20 to 14 per cent; and samples from the first of several milkings went as low as 1.20 per cent of fat.

Sixty-four per cent of the samples of individual milk stood between 3.40 and 5 per cent of fat, and 85 per cent of the samples were unquestionably above the standard of 13 per cent of total solids.

In the case of herd milk the extremes of 2.80 and 5.80 lead us to point to them as object lessons of the tendency of breeding for a definite purpose, to wit, in the one case quantity and in the other quality. One represents the tendency in producing sale milk for a city market, and the other the result of producing milk for a butter or cream trade. With such contradictory motives influencing the producer, the importance of some standard for the protection of the consumer is evident.

The specimens of cream tested showed an amount of butter fat ranging from 10.60 per cent to 42 per cent. With the increasing demand for cream by the city trade, it is apparent from the above range that the door is open for much dishonesty. A legal standard — as in the case of milk — may become necessary. But much better would be the introduction of the system of selling on quality, the producer or dealer guaranteeing on the label of the bottle or can a certain per cent of richness. The extreme figures given above are outside the ordinary limits; the majority of the samples tested between 15 and 20 per cent. Minnesota has a law prohibiting the sale of any cream having less than 20 per cent of fat.

Samples of buttermilk tested ranged from 2.80 per cent of fat to a mere trace, hardly measurable by the Babcock tester. Over two-thirds of the samples had .20 per cent or under.

Samples of skim-milk ranged from 2.60 per cent of fat to an immeasurable trace. Over half were .10 per cent or below.

In the above cases of skim-milk and buttermilk where too great an amount of fat was going to waste, the educational work of the Bureau was of good service.

### MILK STANDARD.

The question of the milk standard was before the last Legislature, and the House passed an act to reduce the standard, but it was killed in the Senate. The Massachusetts standard of 13 per cent is higher than that of a majority of the States. But is not higher than an average of the analyses of many thousands of samples of milk in all parts of the country. But an average implies that there may be quite a considerable number of cows which do not come up to the mark, and possibly much trouble and loss would result if the law were to be literally enforced. But laws are not enforced in such a manner. Courts will not entertain cases in which the evidence is not positive enough to render conviction reasonably certain. A shrewd lawyer, sharp at cross-questioning, may throw a little uncertainty on a chemical analysis within narrow limits. No man could be convicted whose milk analyzed 12.99 per cent of solids, nor 12.90. The analysis must show a result enough below the standard to convince the court beyond a reasonable doubt that the milk was adulterated actually or constructively. But this leeway lets in so many more herds that it reduces very materially the possibility of oppression. If, however, the legal standard should be reduced, in the practical operation of the law the minimum for standard milk would be consequently reduced. Many plausible arguments can be adduced against an arbitrary statute standard, and possibly in the future it will be so modified that all milk will be sold on a guarantee of actual quality. But that time is not yet; and the practical question for consideration is, whether under existing conditions the advantages of the present standard do not more than offset the evils. The present law and its efficient enforcement — so far as Boston is concerned — means more confidence on the part of the consuming public, and hence a greater consumption. If the standard were lowered, it is more than probable that much milk would be correspondingly extended so as to bring it down to the standard, thereby increasing the surplus just so much, while popular confidence might be correspondingly weakened and the demand decreased.

## SUPREME COURT OLEOMARGARINE DECISIONS.

The Statute of 1891, chapter 58, which makes a distinction between oleomargarine which is an imitation of yellow butter and that which is not, and which statute is directed only towards oleomargarine of the former class, is not repealed by the Statute of 1891, chapter 412, section 1, which is directed to the distinct fraud of selling or offering to persons calling for butter something besides butter. The fact that two statutes, similar in their nature and purpose, were both passed at the same session of the Legislature, and took effect on the same day, is strong evidence that they were intended to stand together.

The enactment of a statute which forbids the manufacture and sale of oleomargarine which is made in imitation of yellow butter, though such oleomargarine has been imported from another State, is a valid exercise of the police power which remains in the several States, and it is not in violation of the constitutional provision giving to Congress the power to regulate commerce among the several States. (Commonwealth *v.* Huntley et al.; Benjamin A. Plumley's case, 156 Mass. 236.)

The Statute of 1886, chapter 317, section 4, requires that every person who conveys oleomargarine or butterine in carriages, or otherwise, for the purpose of selling the same in any city or town, shall be licensed by the inspectors of milk of such city or town to sell the same within the limits thereof. But the remainder of the section makes it clear that it was intended to apply only to sales from carriages or other vehicles. As the present complaint has no allegation that the defendant carried or exposed the articles in a carriage or other vehicle, it could not be sustained as a complaint under the Statute of 1886, chapter 317, section 4, and we consider it as based upon the Public Statutes, chapter 68, section 16. So considered, it cannot be sustained. Oleomargarine and butterine are provisions. The word includes all articles of food. The articles with which it is charged the defendant went about, and exposed and sold, are, therefore, included among those which any person may go about selling or exposing for sale under the authority of the Public Statutes, chapter 68, section 1; and the acts charged are not prohibited by the Public Statutes, chapter 68, section 16. (Commonwealth *v.* Lutton, 157 Mass. 392.)

A complaint on the Statute of 1886, chapter 317, section 1, charging the defendant with selling imitation butter at retail without a descriptive wrapper, need not allege that the sale was actually made by the defendant's agent. At the trial of such a complaint there was evidence that the sale was made by the defendant's agent, acting within the scope of his employment, and that he was supplied with wrappers properly marked for covering the article sold; and the presiding judge refused to instruct the jury, as requested by the defendant, that, if the agent's failure to use the wrappers was the result of inadvertence on his part, and not intentional, the jury would not be justified in convicting the defendant. *Held*, that the defendant had no ground of exception. (Commonwealth *v.* Gray, 150 Mass. 327.)

The defendant had for sale in his provision store oleomargarine colored in imitation of yellow butter. It was in a closed and covered refrigerator, and could not be seen by customers, but there was in the store a sign to the effect that oleomargarine was sold there. Upon the occasion to which the complaint relates none of the substance was sold or produced to view, except that a sample was taken from the refrigerator by an agent of an official inspector. The defendant was found guilty in the superior court. The supreme court ordered the verdict set aside, for the following reason: The case turns upon the meaning of the words "expose for sale" in the statute under which the complaint was drawn. The purpose of the statute is to prevent deception in the manufacture and sale of imitation butter, and the statute provides that no person "shall render or manufacture, sell, offer for sale, expose for sale or have in his possession with intent to sell" certain articles. The phrase to be construed is perhaps susceptible of more than one meaning. Whenever goods are placed for convenient delivery upon expected sales they are put out and in one sense exposed for sale, whether visible to customers or not. But in our opinion the words are not so used in the statute under consideration. The prohibited articles are designed and adapted to deceive the eye; and, because their appearance is likely to induce those who see them to buy them as the genuine butter of which they are in imitation, there is special reason for prohibiting their exposure to view. The language is so full that it is not necessary to give it a strained construction in order to make the statute effective. Offering to sell, and having in possession with intent to sell, are likewise prohibited in the same clause and under the same penalty, so that it is easy for the pleader to select language which describes the offence with reasonable accuracy. Similar words are used in the statutes relating to milk and to intoxicating liquors; but as in such cases the charge of exposing for sale is uniformly joined with that of illegal keeping, and as such a complaint charges but one offence and is supported by proof of either act (Commonwealth *v.* Nichols, 10 Allen, 199; Commonwealth *v.* Dolan, 121 Mass. 374), it has not been necessary for this Court to construe the phrase. Some of the decisions, however, intimate more or less clearly that in the statutes concerning liquors it means "expose to view." (Commonwealth *v.* McCue, 121 Mass. 358; Commonwealth *v.* Atkins, 136 Mass. 160.)

Under the English statute (50 and 51 Vict. C. 29, S. 4) it has been held that margarine kept for sale upon the counter of a shop, but behind a screen hiding it from the view of the customers, is not exposed for sale (Crane *v.* Lawrence, L. R. 25 Q. B. D. 152); and that parcels of margarine placed upon a counter or shelf, in view of customers, are exposed for sale, although so wrapped in paper that the margarine cannot be seen. (Wheat *v.* Brown, 1 Q. B. D. 1892, 418.)

Whether, if the defendant had kept the prohibited article in closed tubs or in paper, so that the packages were visible as articles of merchandise on sale in his store, although the oleomargarine itself could not be seen, he would thereby have exposed it for sale, we do not decide. The contention that the article was not prohibited because it was in imitation of artificially colored butter, as well as of genuine butter, at its best needs no consideration. (Commonwealth *v.* Byrnes, Suffolk, ss., 158 Mass. 172.)

The statute requires a placard to be placed "on both sides" of the vehicle. The defendant's wagon was a covered one, with the front and rear ends open. On the inside of the cover on each side was a placard, in form and size such as the statute requires. These placards could be seen from the front and rear of the wagon but could not be seen from the sides thereof. There were no placards on the outer sides of the wagon. The supreme court said: "We are of opinion that placing the placards on the inside of the cover of the wagon was a mere device to evade the manifest intent of the Legislature."

The defendant also contended that the commissioner of internal revenue has made certain regulations which require the place of business of a person intending to sell oleomargarine to be stated, and that the license issued to him states the place; and it stated that selling from a wagon is not allowed. Hence it was argued that, as our statute compels a man to do that which is illegal and criminal under the federal law, our statute is unconstitutional and void.

The court said: "There are several answers to this argument. The regulations of the commissioner of internal revenue are not made part of the report in this case; and we cannot assume the facts to be as stated by the defendant. There is nothing in the act of Aug. 2, 1886, which is inconsistent with our law. The authority given to the commissioner of internal revenue to make all needful regulations for the carrying into effect of the act does not authorize the imposition of a penalty by a regulation where none is imposed by the act. (United States *v.* Eaton, 12 Sup. Ct. Rep. 764.) If the defendant had a license under the act of Aug. 2, 1886, and has paid a tax, this affords him no immunity. Section 3 of that act, by incorporating section 3,243 of the U. S. Revised Statutes into it, expressly repels the inference that the payment of such a tax will legalize the traffic, and implies that the prohibition or regulation of such traffic by State legislation is permissible." (State *v.* Newton, 21 Vroom, 534 ; Commonwealth *v.* Crane, Suffolk, ss., March, 1893, 158 Mass. 218.)

The Statute of 1891, chapter 412, section 5, requires every person who furnishes, or causes to be furnished, to a guest in a restaurant or a hotel, or at a lunch counter, oleomargarine or butterine in the place or stead of butter, to notify him that the substance furnished is not butter. The defendant was the proprietor of a restaurant at which oleomargarine was furnished to one Quinn, in the place or stead of butter. No oral notice was given to him. There were signs in conspicuous places in the restaurant bearing the words, "Butterine used only here," and on the tables were bills of fare on which were printed the words, "Only fine butterine used here;" but Quinn saw neither of the signs, and did not examine the bill of fare, and so had no actual notice that the substance furnished him was not butter. Upon these facts the jury returned a verdict of guilty; the defendant excepted and the supreme court overruled the exception, saying: "If he had read the signs, or the statement printed on the bill of fare, he would have had sufficient notice; for, if knowledge that the substance furnished is not butter is in any way effectually communicated to the guest, the law is complied with. The statute does not require a distinct statement, either oral or written, to be given to each guest on every occasion when he is furnished with oleomargarine or butterine in the place or stead of butter, but is satisfied if, by any act of the person who furnishes it or causes it to be so furnished, the guest is made aware of the fact that the substance furnished is not butter." (Commonwealth *v.* Stewart, Suffolk, ss., May, 1893, 159 Mass. 113.)

Dealers in oleomargarine in this Commonwealth may often receive packages of oleomargarine from manufactories in other States marked according to the laws of the United States and not according to the laws of this Commonwealth. If, on receiving such packages, they store them with the intention of marking them as required by our statutes before they either expose them for sale, or sell them or intend to sell them, there is no violation of our laws.

It was a question of fact, then, whether the defendant had in his possession, with intent to sell, packages of oleomargarine not marked as required by our statutes. The exceptions recite that "the tub in question was not on the date of the offence alleged in the complaint exposed for sale, nor was it so situated that it could be seen by customers of the defendant;" and that "it also appeared from the evidence that the defendant had bought said package for the purpose and with the intention of selling the said oleomargarine contained therein at retail in said store, but that he did not intend to sell the oleomargarine contained in this tub, or expose the same for sale until the marks had been examined, and if not marked in accordance with law to mark the tub before opening the same." Taking these facts to be true, we are of opinion that the jury were not warranted in finding the defendant guilty. They show that the defendant had no intention of selling the oleomargarine in the form which it was in, but was storing it with the intention of properly marking the package, if it was not already properly marked, before he offered the oleomargarine for sale or intended to sell it. Under complaints for keeping intoxicating liquor with intent unlawfully to sell it, the intent is a question of fact to be proved (Commonwealth *v.* Ham, 150 Mass. 122); but because of the absolute prohibition against selling without a license, the intent to sell may be often inferred from facts which would not warrant the inference of an intent to sell other merchandise in the form in which it was found, when defendant had a right to sell it if it was properly marked, and had the right to so mark it after receiving it and before he exposed it for sale or intended to sell it. Commonwealth *v.* Mills, Bristol, ss., November, 1892, 157 Mass. 405.)

The only contention made in the argument before this court on the motion to quash the complaint is that the complaint should have been made by an inspector of milk or by the treasurer of the town in which the offence was committed. The Legislature has prohibited unqualifiedly the sale, exposing for sale, or having in possession with intent to sell, oleomargarine, except under certain conditions; and it is to be presumed that it has done this to promote the welfare generally of the inhabitants of the Commonwealth. (See Statute of 1890, chapter 440, section 57; Statute of 1890, chapter 416, section 1.) But it is not to be inferred that the Legislature, merely by making it the duty of certain officers, to enforce penal laws of general application, intended that the enforcement should be dependent upon the discretion of these officers. The motion to quash the complaint was rightly overruled. (Commonwealth *v.* McDonnell, Bristol, ss., November, 1892, 157 Mass. 407.)

Oleomargarine was exposed for sale in the original package, namely, a tub, the top of the cover of which had been duly marked, as well as the side and bottom, but from which the cover had been removed, disclosing the superficial surface of the oleomargarine without any mark. *Held*, that the terms of the Statute of 1886, chapter 317, section 1, had been complied with. (Commonwealth *v*. Bean, 148 Mass. 172.)

## Supreme Court Milk Decisions.

The fact that a collector of samples makes a purchase of milk in a restaurant and retains a portion thereof for analysis, without disclosing that he is such a collector, and without giving to the person from whom it was purchased an opportunity to ask for a sealed sample, will not render evidence incompetent to show that the milk so purchased was below the legal standard. (Commonwealth *v*. Coleman.)

The provisions of section 2, chapter 318, Statute of 1886, apply to the keeper of a hotel who supplies milk to his guests to be drunk by them on the premises.

A principal is responsible under the statute for a sale made by his servant, although he was not present, and did not consent to or know of the particular sale, the servant not acting in violation of orders. (Commonwealth *v*. Vieth, 155 Mass.)

Under the Public Statutes, chapter 57, section 5, as amended by the Statutes of 1886, chapter 318, section 2, relating to the adulteration of "milk," it is equally an offence to have in one's possession skimmed milk containing a foreign substance with intent unlawfully to sell the same. (Commonwealth *v*. Wetherbee, 155 Mass.)

On a complaint for the sale of milk not of good standard quality, evidence that the milk was delivered under a special contract is immaterial.

If a buyer of milk takes a portion to a milk inspector, the latter may testify on the trial of such a complaint as to the results of his analysis. (Commonwealth *v*. Holt, 146 Mass. 38.)

At the trial of a complaint, on the Statute of 1886, chapter 318, section 2, for selling milk not of the standard quality, there being evidence that the milk was skimmed milk, and sold from a measure duly marked, the jury were instructed that the defendant would be liable unless he sold the milk not as pure milk, but as skimmed milk, and, further, that he would be liable unless the buyer had notice or knowledge that the milk was skimmed milk. *Held*, that the instruction was erroneous. (Commonwealth *v*. Smith, 149 Mass. 9.)

Dennis J. Quinn, a duly appointed agent of the Boston inspector of milk, purchased a half-pint of cream, which was delivered to said Quinn by the defendant. The analysis of said substance so sold and delivered as cream showed that it contained an added foreign substance, to wit, boracic acid, a compound of boron.

The jury returned a verdict of guilty, and defendant excepted. The Supreme Court overruled the exception, saying: "The word milk in the Public Statutes, chapter 57, 'of the inspection and sale of milk,' is shown by section 7 to include milk from which no part of the cream has been removed; and we are of the opinion that it is used as a general name, and in a sense broad enough to include cream. The offence under section 5, of having in one's possession, with intent to sell, milk to which a foreign substance has been added, is committed by having, with that intent, cream to which boracic acid has been added." (Commonwealth *v.* Gordon, Suffolk, ss., April, 1893.)

Public Statutes, chapter 57, section 2, so far as it authorizes inspectors of milk to enter all carriages used in the conveyance of milk, and, whenever they have reason to believe any milk found therein is adulterated, to take specimens thereof for the purpose of analyzing or otherwise satisfactorily testing the same, is constitutional. (Commonwealth *v.* Carter, 132 Mass., 12.)

1. A person may be convicted of selling adulterated milk, under Public Statutes, chapter 57, section 5, although he did not know it to be adulterated; and an averment in the indictment that he had such knowledge may be rejected as surplusage.

2. It is not necessary in such indictment to aver that the milk was cow's milk.

3. An indictment alleging a sale of adulterated milk to a woman is not defeated by proof that she was married and was acting as agent for her husband, if the seller had no notice, express or implied, of these facts.

4. An indictment under Public Statutes, chapter 57, section 5, which charges that the defendant sold a certain quantity of "adulterated milk, to which a large quantity — that is to say, four quarts — of water had been added," is not bad for duplicity. (Commonwealth *v.* Farren, 9 Allen, 489.)

1. An indictment which alleges that the defendant "did unlawfully keep, offer for sale, and sell" adulterated milk, charges but one offence.

2. In support of such indictment, one who in a great many instances has used a lactometer for the purpose of testing the quality and the purity of milk may testify to the result of an experiment made by him with the same lactometer upon the milk

in question, although no evidence is offered as to the character of the instrument. (Commonwealth *v.* Nichols, 10 Allen, 199.)

At the trial of an indictment on Public Statutes, chapter 57, section 5 (Statute of 1868, chapter 263), for selling "adulterated milk, there was evidence that the defendant [who was a son of the owner of a milk route], with a companion who was in the same employment with himself, knowingly adulterated milk on its way for distribution to his father's customers, and then having charge, with his companion, of its distribution from the wagon on which it was conveyed upon the route, caused a can of it to be delivered to one of the customers by the hand of his companion. *Held*, that he had no ground of exception to instructions to the jury; that in the absence of proof of any previous contract to supply milk to the customer, the delivery might be deemed an act of sale; nor to an instruction framed on a supposition that the jury might find that he was in the employment of his father, although there was no averment in the indictment to that effect." (Commonwealth *v.* Haynes, 107 Mass., 194.)

A person may be convicted of selling adulterated milk, upon a complaint under Public Statutes, chapter 57, section 5 (Statute of 1880, chapter 209, section 3), without allegation or proof that he knew it to be adulterated. (Commonwealth *v.* Evans, 133 Mass., 11.)

A complaint, under Public Statutes, chapter 57, section 5, alleging that the defendant, at a time and place named, had in his possession a certain quantity, to wit, one pint of adulterated milk, containing less than thirteen per cent of milk solids, with intent then and there unlawfully to sell the same, is sufficient, without further alleging that the milk was analyzed and found on analysis to contain less than thirteen per cent of milk solids. At the trial of a complaint, under Public Statutes, chapter 57, section 5, alleging that the defendant had in his possession adulterated milk, to wit, milk containing less than thirteen per cent of milk solids, with intent to sell the same, it is immaterial in what manner the quantity of milk solids has been reduced below thirteen per cent, if the intent is to sell the milk as pure milk, and not as skimmed milk. (Commonwealth *v.* Bowers, 140 Mass., 483.)

Public Statutes, chapter 57, section 9 (Statute of 1880, chapter 209, section 8), providing that "in all prosecutions under this act," for selling adulterated milk, "if the milk shall be shown upon analysis to contain more than eighty-seven per centum of watery fluid, or to contain less than thirteen per centum of milk solids, it shall be deemed for the purpose of this act to be adulterated," is constitutional. (Commonwealth *v.* Evans, 132 Mass., 11.)

A complaint, under the Public Statutes, chapter 57, sections 5, 9, alleging that the defendant, at a time and place named, had in his custody and possession a certain quantity, to wit, one pint, of adulterated milk, to wit, milk then and there containing less than thirteen per cent of milk solids, with intent then and there unlawfully to sell the same, is sufficient. (Commonwealth *v.* Keenan, 139 Mass., 193.)

The Public Statutes, chapter 57, section 10, do not prohibit any person not an inspector of milk from making a complaint for a violation of the provisions of the chapter.

A complaint, under the Public Statutes, chapter 57, section 5, alleging that the defendant sold one pint of adulterated milk, to wit, milk containing less than thirteen per cent of milk solids, is not supported by proof that he sold the milk as skimmed milk out of a tank marked as required by section 7, although the milk was watered.

A complaint under Public Statutes, chapter 57, section 5, alleging a sale of adulterated milk, to wit, milk containing less than thirteen per cent of milk solids, is supported by proof of a sale of milk which, by the removal of a part of the cream, has been reduced in solids below thirteen per cent, unless the milk was sold as skimmed milk, and out of a vessel, can or package marked as required by section 7; and it is not necessary that a complaint charging such an offence should be drawn under section 6. (Commonwealth *v.* Tobias, 141 Mass., 129.)

At the trial of an indictment on Public Statutes, chapter 57, section 5, charging the defendant with having adulterated milk in his possession, with intent unlawfully to sell the same, an analyst in the employ of the inspector of milk may testify to the result of his analysis of the milk taken from the defendant from memory, using a memorandum made by him at the time of analysis to refresh his memory, without further proof that the requirements of the Public Statutes, chapter 57, section 2, as amended by the Statute of 1884, chapter 310, section 3, have been complied with. (Commonwealth *v.* Spear, 143 Mass. 172.)

At a trial of an indictment on the Public Statutes, section 5, charging the defendant with having adulterated milk in his possession, with intent to unlawfully sell the same, an analyst in the employ of the inspector of milk, who analyzed the milk taken from the defendant, testified that he reserved a portion of the milk so taken, by putting it into a bottle, which he corked and sealed. A chemist, to whom the analyst delivered the portion of the milk so reserved, testified, for the defendant, that the bottle was not sealed. The defendant asked the judge to rule that, if the bottle was corked only, it was not a compliance with the requirement of the Statutes of 1884, chapter 310, section 4, as to the sealing of such reserved portion. The judge declined so to rule, and instructed the jury that they might consider the evidence as bearing upon the credibility of the government witness. *Held*, that the defendant had no ground of exception.

If, at the trial of an indictment on the Public Statutes, chapter 57, section 5, charging the defendant with having adulterated milk in his possession, with intent to unlawfully sell the same, an analyst in the employ of the inspector of milk of a city testifies that he added, for the purpose of preserving it, a few drops of carbolic acid to the sample reserved from milk delivered to him for analysis, it is a question of fact for the jury whether the reservation of the sample was in accordance with the requirement of the Statute of 1884, chapter 310, section 4. (Commonwealth *v.* Spear, 143 Mass. 172.)

At the trial of a complaint, under Public Statutes, chapter 57, section 5, alleging that the defendant had in his possession adulterated milk, with intent unlawfully to sell the same, the evidence showed that a wagon with the defendant's name and number on it was standing upon a public street in a city at an early hour in the morning; that the defendant's servant was on the wagon, and there were several eight-quart cans in the wagon; that a collector of samples in the employ of the inspector of milk for the city took a sample of milk from one of the cans, which was not marked "skimmed milk," and that an analysis of the milk taken showed that it was below the legal standard. *Held*, that there was evidence of an intent on the part of the defendant to sell the milk, which was properly submitted to the jury. (Commonwealth *v.* Smith, 143 Mass. 169.)

A complaint on the Statute of 1886, chapter 318, section 2, alleging that on the first day of July, 1886, the defendant had in his possession "one pint of milk not of good standard quality, that is to say, milk containing less than thirteen per cent of milk solids, with intent then and there unlawfully to sell the same within this Commonwealth," is sufficient, without negativing the exception of the months of May and June.

The Statute of 1885, chapter 352, section 6, provides that section 9 of the Public Statutes, chapter 57 (which relates to the sale of adulterated milk), "is hereby amended so as to read as follows." The Statute of 1886, chapter 318, section 2, provides that section 9 of the Public Statutes, chapter 57, "is hereby amended so as to read as follows." In each section, after the words quoted, there follows a sentence which covers the whole subject of the original section. *Held*, that the Statute of 1886, chapter 318, section 2, was a valid enactment.

The Statute of 1884, chapter 310, section 4, providing for the reservation and sealing, before commencing the analysis, of a portion of the sample of milk taken for analysis, is impliedly repealed by the Statute of 1886, chapter 318, sections 1 and 3. (Commonwealth *v.* Kenneson, 143 Mass. 418.)

The Statute of 1885, chapter 352, section 8, provides that no person shall sell, or have in his possession with intent to sell, skimmed milk below a certain standard, and enacts that whoever violates the provisions of this section shall be punished by the penalties provided in the Public Statutes, chapter 57, section 5. *Held*, on a complaint made under the Statute of 1885, chapter 352, section 8, for an offence committed after the Statute of 1886, chapter 318, section 2, took effect, that, even if the last-named statute repealed by implication the Public Statutes, chapter 57, section 5, the complaint could be maintained. (Commonwealth *v.* Kendall, 144 Mass. 357.)

Placing wax upon the top of the cork in a bottle containing a portion reserved from a sample of milk taken for analysis, and not extending the wax over the mouth of the bottle and thus rendering the bottle air tight, is not a sufficient compliance with the requirement of the Statute of 1884, chapter 310, section 4, that such reserved portion shall be "sealed." (Commonwealth *v.* Lockhardt, 144 Mass. 132.)

An indictment on the Statute of 1886, chapter 318, section 2, alleging that the defendant had in his "possession milk to which a certain foreign substance had been added, to wit, annatto coloring matter," with intent unlawfully to sell the same, is sufficient without naming the quantity. Evidence offered at the trial of such an indictment as to two samples of milk taken from the defendant's possession at substantially the same time is competent, and the government cannot be required at the same time of the offer, if ever, to elect which sample it will rely on. The addition of the annatto coloring matter, whether injurious to health or not, is punishable under the statute. Evidence that the "milk was of low grade" is competent, although it may tend to prove another offence. (Commonwealth *v.* Schaffner, 146 Mass. 512.)

An averment in a complaint under the milk acts, that the defendants were "partners," is mere surplusage, and need not be proved. On such a complaint, evidence that the defendant was on a wagon with a license number on it, and containing milk cans, from one of which was taken adulterated milk, is competent on the issue that he was in possession of the milk to sell it. (Commonwealth *v.* Rowell, 146 Mass. 128.)

## FINANCIAL STATEMENT.

| | | |
|---|---|---|
| Appropriation by Legislature of 1893, . . | $4,000 00 | |
| C. L. HARTSHORN, *Chairman:* — | | |
| Travelling and necessary expenses, . . . | | $40 00 |
| Twelve days' services, . . . . . | | 60 00 |
| G. L. CLEMENCE: — | | |
| Travelling and necessary expenses, . . | | 68 00 |
| Twelve days' services, . . . . . | | 60 00 |
| D. A. HORTON: — | | |
| Travelling and necessary expenses, . . | | 35 00 |
| Seven days' services, . . . . . | | 35 00 |
| G. M. WHITAKER, *Assistant Executive Officer:* — | | |
| Travelling and necessary expenses, . . | | 280 38 |
| J. W. STOCKWELL, *Agent:* — | | |
| Salary, . . . . . . . | | 1,140 00 |
| Travelling and necessary expenses, . . | | 731 76 |
| C. C. HALL, *Agent:* — | | |
| Services and expenses, . . . . . | | 57 34 |
| JAMES CHEESMAN, *Expert:* — | | |
| Services and expenses, . . . . . | | 26 08 |
| E. A. HARRIS, *Expert:* — | | |
| Services and expenses, . . . . . | | 29 10 |
| Analyses and tests, . . . . . . . | | 579 00 |
| Legal services, . . . . . . . | | 43 00 |
| Printing, . . . . . . . . . | | 95 78 |
| Supplies, . . . . . . . . . | | 56 46 |
| | $4,000 00 | $3,336 90 |

Respectfully submitted,

GEO. M. WHITAKER,
*Assistant Executive Officer.*

Approved and adopted as the report of the Dairy Bureau.

C. L HARTSHORN.
GEO. L. CLEMENCE.
DWIGHT A. HORTON.

BOSTON, Jan. 11, 1894.

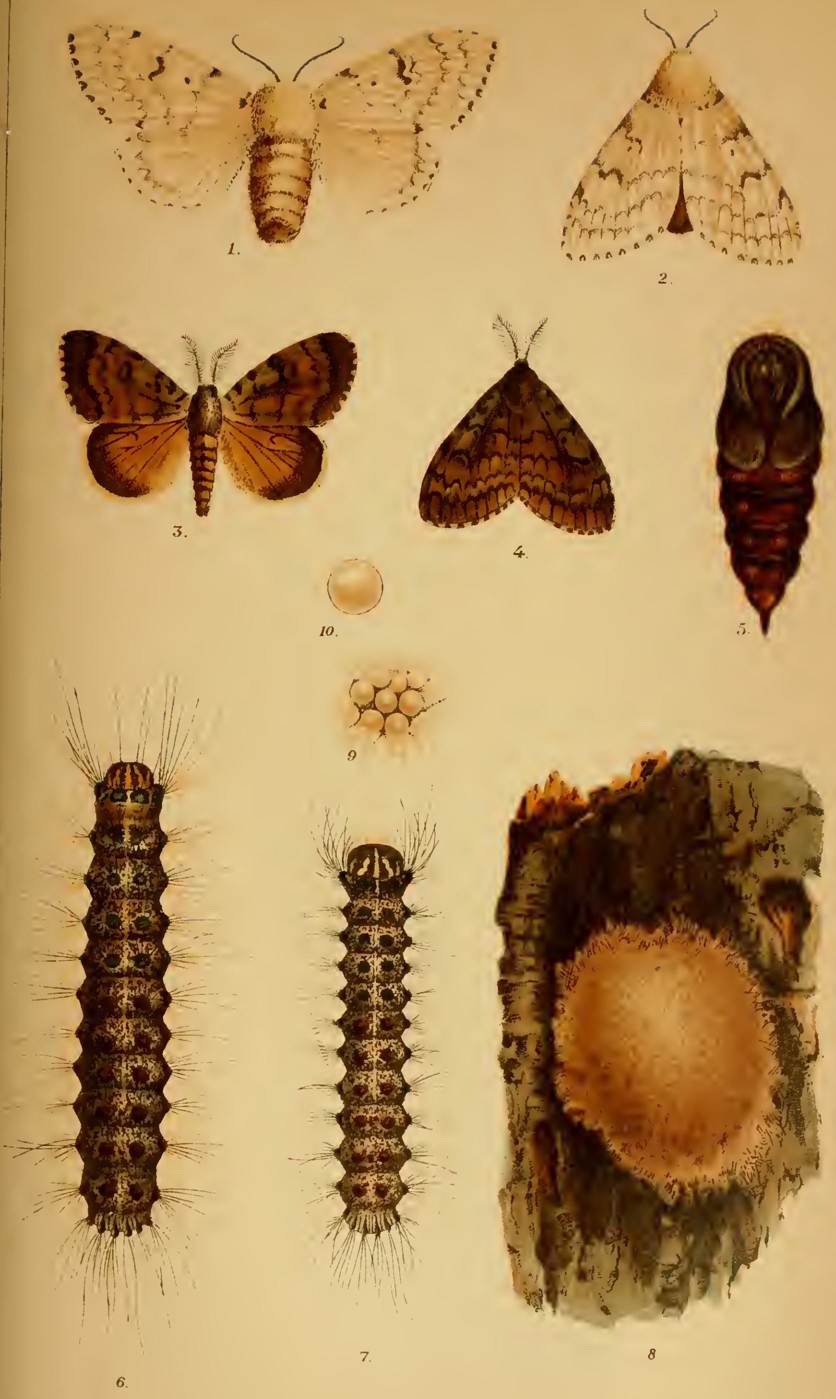
# EXPLANATION OF PLATE I.

## GYPSY MOTH (Ocneria dispar, L.)

Fig. 1.— Female with the wings spread.
2.— Female with the wings folded.
3.— Male with the wings spread.
4.— Male with the wings folded.
5.— Pupa.
6.— Caterpillar. } Full grown.
7.— Caterpillar. } Full grown.
8.— Cluster of eggs on bark.
9.— Several eggs enlarged.
10.— One egg greatly enlarged.

Figures 1 to 8, inclusive, natural size.

Plate I



Drawn by Joseph Bridgham.

Heliotype Printing Co. Boston

GYPSY MOTH.

# REPORT

OF THE

# STATE BOARD OF AGRICULTURE

ON THE WORK OF

# EXTERMINATION OF THE GYPSY MOTH.

*To the Senate and House of Representatives of the Commonwealth of Massachusetts.*

I have the honor to present herewith to the General Court the report of the gypsy moth committee of the State Board of Agriculture to said Board, and the reports of the director of field work and the entomological advisor to said committee as the report of the State Board of Agriculture on the extermination of the gypsy moth; the statement of receipts and expenditures and the recommendations and suggestions contained in said reports being adopted by said Board and presented in accordance with the provisions of chapter 210, Acts of 1891, as their recommendations and suggestions.

WM. R. SESSIONS,
*Secretary of the State Board of Agriculture.*

BOSTON, Jan. 10, 1894.

*To the Massachusetts State Board of Agriculture.*

In accordance with the provisions of law, the gypsy moth committee of the State Board of Agriculture presents the report of expenditures and work performed in the endeavor "to prevent the spreading and to secure the extermination of the *Ocneria dispar*, or gypsy moth, in this Commonwealth."

The presence of this insect pest was first brought to public notice in June, 1889. The Legislature of 1890 authorized the Governor to appoint a commission to take the matter in charge and appropriated $25,000 to carry on the work. Subsequently the same Legislature made an additional appropriation of the same amount. A commission was appointed and carried on the work until Feb. 15, 1891, when it was superseded by a new commission consisting of the Secretary and two members of the State Board of Agriculture. This commission commenced operations in March, 1891. An act of the Legislature approved April 17, 1891, transferred the work and all unexpended funds in the hands of the commission to the State Board of Agriculture, authorizing said Board to "exercise all the duties and powers" thus conferred upon it "by and through its Secretary and such members of said Board as it may designate and appoint" for the purpose. There remained of the amount appropriated for the work in 1890 nearly $25,000, and the Legislature of 1891 appropriated $50,000 in addition to this sum.

The task given the Board of Agriculture by the Legislature was to prevent the spreading and to secure the extermination of the gypsy moth. At that time the moth was supposed to be confined to Medford, Malden, Arlington, Everett and Chelsea, with the exception of a few colonies in North Cambridge and Somerville, one in Winchester and one in Belmont. With funds available amounting to about $75,000, the task of determining the boundaries of the region occupied by the moth was begun. Beginning at

Medford a search was made which extended through forty-two towns and cities and resulted in finding the moth in thirty townships. This search occupied the entire season, and by it the fact was determined that the insect had spread into most of the outer towns within the few previous years.

It was proved by the experience of 1891 that spraying with known insecticides would never bring about extermination, and other means of destruction were tried. During the season the moths were reduced 90 per cent. in numbers.

In 1892 the committee asked for and received an appropriation of $75,000. During that year the infested towns were inspected as carefully as possible and fifty-three towns outside the infested region were visited, but no moths were found in any of the latter. During this season the moth was exterminated from hundreds of localities, several towns were nearly cleared of them, and the numbers of the moth were again greatly reduced.

In the summer of 1892 a means of trapping the caterpillars was put into extensive use. Bands of burlap were placed about the infested trees and those near by. As these bands were frequently visited to kill the moths found under them, new colonies were discovered, requiring further banding, and it soon became evident that the force of men would have to be increased in order properly to attend the traps and inspect the region round about them. The lessening numbers of the moth increased the work of inspection and made it more arduous. The great increase in the number of trees burlapped necessitated a larger force of men for the frequent examinations which were necessary if the largest possible advantage from the work was to be attained. These unexpected conditions greatly increased expenses and the appropriation for 1892 was found inadequate. That careful inspection of the infested territory which is so necessary to the successful completion of the labors of the Department could not be carried on in the winter of 1892–93 owing to lack of means. The few men employed were busied in cleaning up infested localities while awaiting an appropriation for the work of the season.

In January, 1893, a careful estimate was made of the amount of money which would be required to inspect the known infested territory and the towns immediately outside of it, and to do all the effective work possible in one year towards the extermination of the moth, and an appropriation of $165,000 was asked for. An appropriation of $100,000 was made by the Legislature and approved April 12, 1893. While the work was suspended awaiting the appropriation several of the best and most experienced men left the employ of the committee for other situations, thus greatly reducing the efficiency of the force. By reason of this delay also, at least six weeks of the best working time of the year passed by unutilized. It was evident that with an appropriation more than one-third smaller than that deemed necessary by the committee, some parts of the field would have to be (to a certain extent) neglected that other parts might be cleared. It was then decided not to attempt to exterminate the moth from the central towns in 1893, but to hold them in check there and, if possible, destroy those in the outer towns, thus reducing the area to be worked thereafter. In pursuance of this plan a large part of the force was distributed in the peripheral towns. A sufficient number of men were stationed in each town to do all that could be done to advantage towards securing there the extermination of the moth as speedily as possible.

A large amount of money was spent in inspection or searching the towns just outside the limit within which the moth had been already found. Many points in this territory had been quite as much exposed to the possible introduction of the moth as some localities where it was known to exist. It was also imperative that all the territory in the towns but little infested should be thoroughly gone over. While this work did not directly operate to reduce the number of moths, the information thus obtained was absolutely necessary to enable the director to work intelligently on the whole problem of extermination. Nearly $13,000 was expended in this work of searching. Only three colonies were found in the outside territory, and all but one of them are in close proximity to the boundaries of infested towns. The effort at extermination in the outside towns has, we believe, been quite successful, and the territory for future work other than inspection has thereby been materially reduced. The condition of the worst infested territory is believed to be better than it was one year ago, notwithstanding the fact that lack of funds obliged the committee to reduce the amount of work done there to the minimum.

The plan proposed last year and submitted to the Legislature, with request for an appropriation of $165,000, contemplated the employment of a sufficient force to do all that it was thought would contribute toward extermination in all the infested territory. With only about sixty per cent. of the appropriation asked for, only sixty per cent. of the work contemplated could be done, and as the plan could not be completely carried out, the season's work in many places is necessarily left in an unfinished condition. This condition will necessitate a larger expenditure next season to complete the work than would have been necessary while it was in hand the past season. The committee believe that the economical continuation of the effort to exterminate demands that all the work possible tending to the end in view should be done at once. The sooner the work is reduced to a simple work of inspection the sooner can the amount of the appropriations be safely reduced. The sum asked for last year can, we believe, be economically applied during the coming year, and we therefore recommend that $165,000 be appropriated for the work of the ensuing year.

It will be remembered that the Legislature of 1893 by resolve requested "the Senators and Representatives from the Commonwealth in the Congress of the United States to urge upon Congress the necessity of prompt and vigorous action to exterminate said pest (gypsy moth), and to use their influence to secure from Congress an appropriation of one hundred thousand dollars to assist the Commonwealth in defraying the necessary expenses of the work." A committee was sent to Washington to assist in the matter by interviewing the Secretary of Agriculture, the committees on Agriculture and Appropriations. From what this committee could learn and from recent communications from the Secretary of Agriculture, we are satisfied that no assistance can, for the present at least, be expected from the general government.

Early in the summer of 1893 five of the most experienced entomologists of the neighboring States, holding important positions in experiment stations or State educational institutions, were invited to examine the work of the committee and make criticisms and suggestions. For their conclusions and criticisms we refer to the report of the advising entomologist of the committee, presented as a part of this report.

### Plan of Work for 1894.

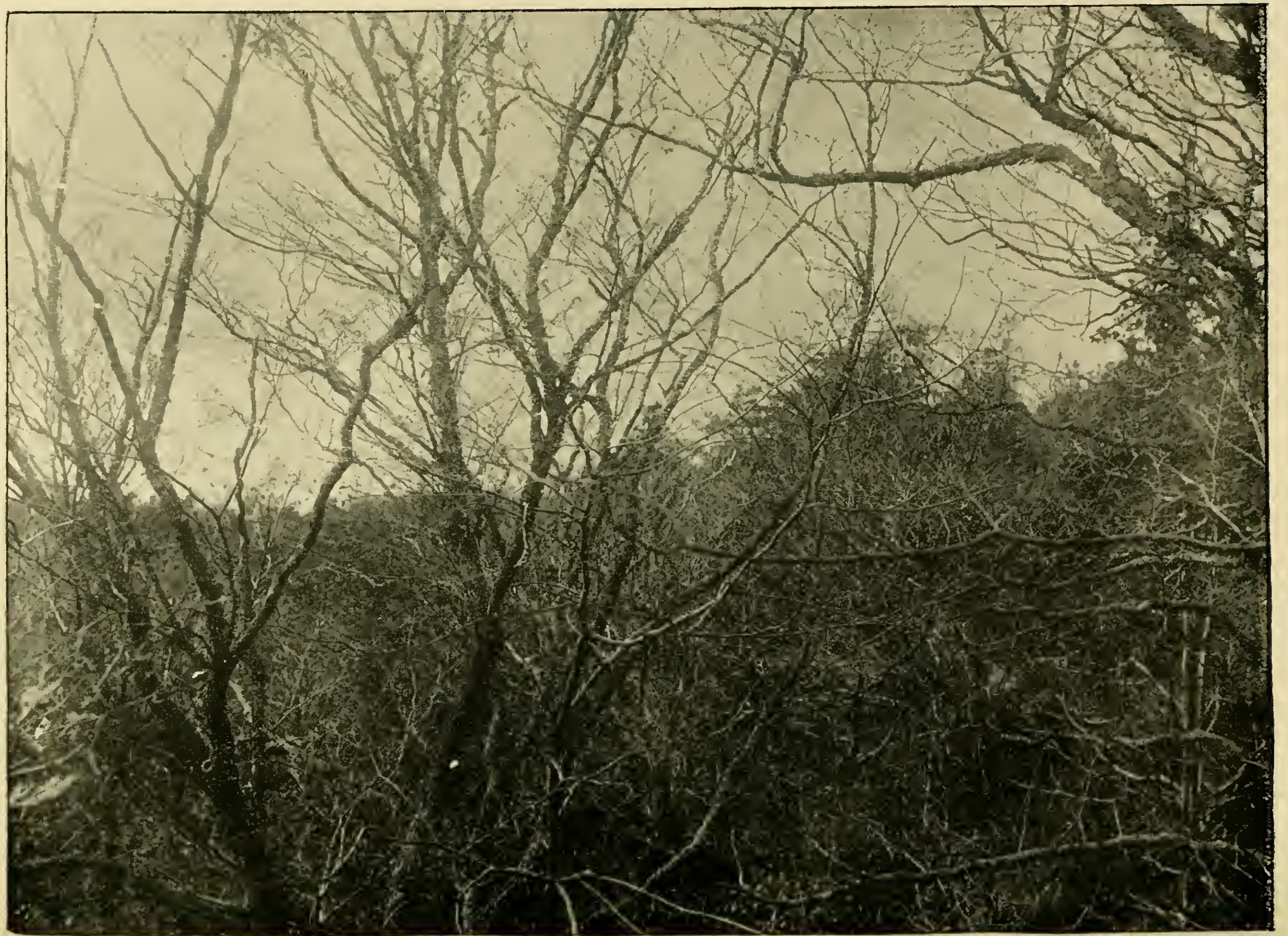
First in order we place the inspection of all territory which it is thought may possibly be infested, together with the inspection of a considerable territory outside the towns known to be infested. The magnitude of this work is beyond the comprehension of the casual observer. Here is a territory of four hundred square miles that should be most carefully examined. In most parts of it every tree and shrub, as well as the ledges and loose rubbish, must be carefully examined. That gone over last year must be as carefully examined again, for assurance must be made doubly sure. If by any chance a single egg cluster has been overlooked it must be found. If neglected it will be a centre from which the pest will again spread, as a new conflagration will be likely to spread from a single neglected ember. In this territory are about 12,000 acres of woodland which may be more or less infested. It probably contains more than 5,000,000 trees, besides the undergrowth. This territory has not thus far had a tree-by-tree inspection on account of lack of money. While this woodland must remain a menace to the work until absolutely cleaned out or burned up, the enormous expense of tree-to-tree examination and the opposition of the people to destruction by fire has led the committee to consider the possibility of other plans for the woodland. Small areas here and there in the woodland are known to be infested, while others may be. The trees for some distance around these infested spots should be burlapped and carefully watched, and the remaining portion kept under surveillance for another year. Persistent efforts have been made to find a feasible plan for dealing with this forest problem. They should be continued with the hope that a plan may be found by which complete extermination may be accomplished without the expensive or drastic measures heretofore contemplated. If careful observation shall prove that the insects have only taken possession of small areas in different parts of the wooded territory, this problem will be much simplified.

### Burlapping.

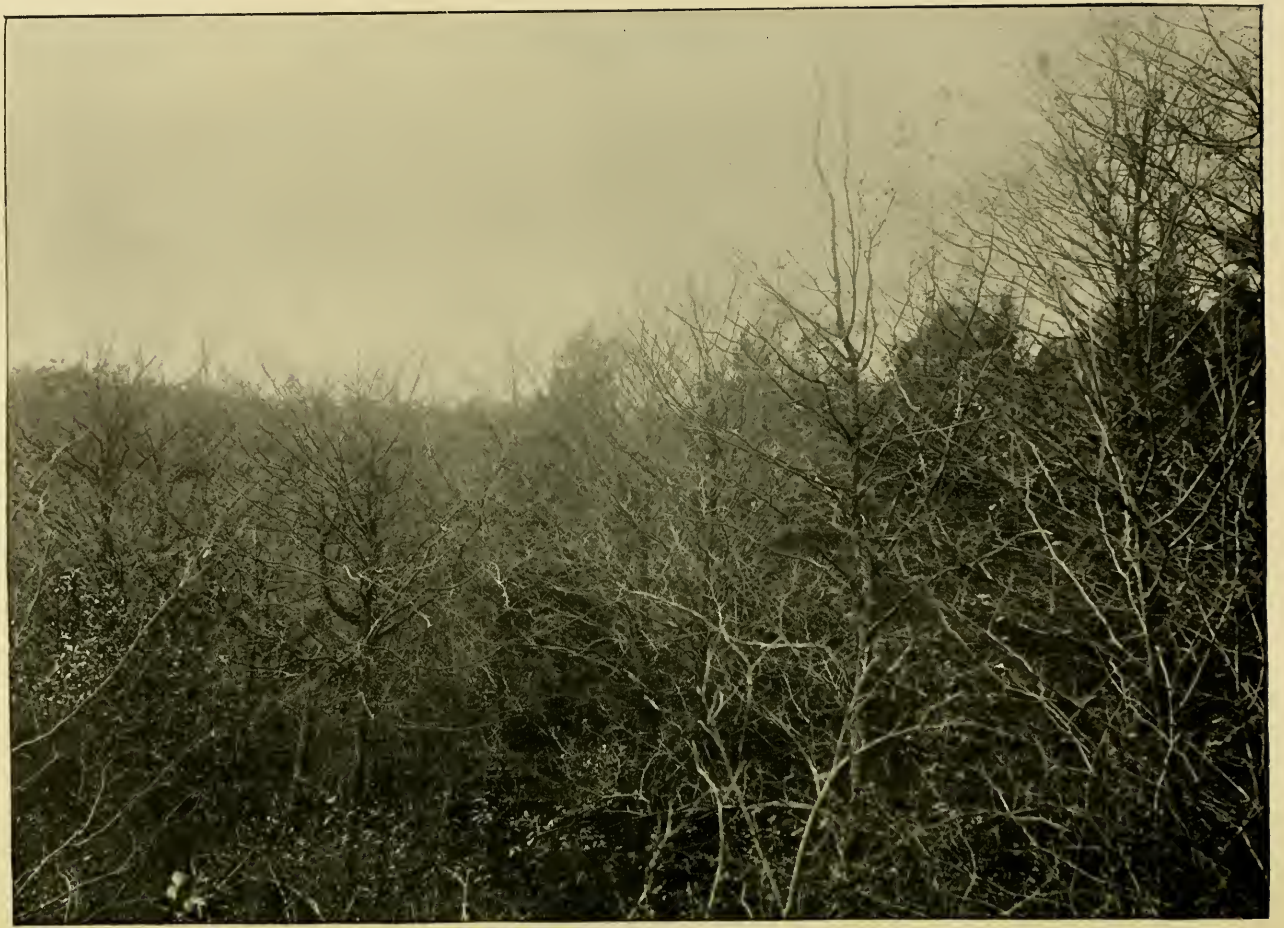
The experience of the past two years has proved to the committee that burlapping is one of the most effective methods of dealing with the gypsy moth; but to be effectual it is necessary that a sufficient number of men be employed to examine all the burlaps daily and kill all the caterpillars found under them. Lack of money has heretofore prevented a daily examination of the burlaps in the territory most centrally located and most thoroughly infested. The trees in the immediate vicinity of all known infested localities should be burlapped. This would include almost all the trees in Malden, Medford and Everett, and those in large sections of Revere, Melrose, Arlington and several other towns. The work of attending to the burlaps ceases at the close of the caterpillar season, or about the first of September. From that date the men should be put to inspecting and cleaning up known colonies until the leaves have fallen. The entire force should be employed for the remainder of the year in inspecting the whole territory. The work of past years must be verified as well as the work of the last season.

If less than the sum recommended should be appropriated, the committee would be obliged to limit the work done in the most seriously infested and most central territory to just sufficient to prevent the insects from increasing there, and emplcy the balance of the force that the appropriation would warrant the committee in retaining, in inspecting or searching the outside territory and cleaning up the outlying colonies. The inspection *must* be done to prevent the spreading. The amount that can be accomplished in the line of extermination depends entirely upon the size of the appropriation.

If the work of destroying the gypsy moth should now be discontinued there would probably be very little damage done for a year or two by the caterpillars. As a result of the work already done the moths are now very rare except in limited localities in the central towns of the infested district. But they are scattered here and there over a large part of this whole area, in small colonies such as started



View of a portion of woodland attacked by the gypsy moth at Cedar Hill, Swampscott, Mass.



View of another portion of woodland attacked by the gypsy moth at Cedar Hill, Swampscott, Mass.

(From a photograph taken in August, 1891 ) from the original importation by Mr. Trouvelot in Medford. Each of these colonies would gradually increase. The growth and increase of each colony would be slow at first and perhaps unnoticed. Year by year this increasing growth would result, first, in damage at the originally infested centres, and next in a gradual dissemination and extension of the moth. New colonies would be formed and in a few years' time great damage would be done in localities, as in the past. Such damage would continue and increase in spite of the efforts of individual citizens to prevent it, as was the case in Medford during the few years before 1890. Then would come the entire defoliation of trees, shrubs and all vegetation, which would result in the destruction of fruit and shade trees, the despoiling of gardens, small fruits and shrubbery. In the meantime the moths would be spreading into the woods. They would be gaining a foothold in public parks, and extending out into towns never before infested. As in the past, this condition of things would grow worse year by year. During the spring and summer months trees in our parks and pleasure grounds which are ordinarily covered and protected by their foliage would be stripped and bare, their trunks and branches a mass of crawling caterpillars. Parks, roadsides, woodlands, orchards, gardens, and, in fact, all portions of the infested area where plants or trees grow would be invaded by hosts of voracious caterpillars, which would be spinning down from the trees in great numbers upon passing vehicles and upon the persons of the inhabitants.

Experience has shown that where these caterpillars become numerous they crawl in great numbers upon and into the houses and buildings of all kinds; in fact, they intrude their disgusting presence everywhere. Wherever they become most numerous, so that the foliage disappears and food becomes scarce, the weaker are constantly dying, and the stench from their decaying bodies is nauseating. Such has been the condition where they were most numerous in the past, notwithstanding the most strenuous efforts of individuals to check them. The dissemination of the moth over this and adjoining States would probably not be so rapid as that of some other noxious insects in the past. But experience has shown that it is likely to increase very rapidly wherever it has obtained a foothold, and that it will become locally more destructive by reason, perhaps, of the comparative slowness of its dissemination. In the Old World it has extended its range into tropical countries, and should it extend into the Southern States it would probably be still more destructive there than here, as the number of broods produced annually usually increases in the long summer of those latitudes. A conservative estimate made by Professor Fernald places the probable annual damage which this insect would do in Massachusetts alone, if allowed to spread, at one million dollars.

To show what would be the probable condition in large areas of territory in a few years, should the work cease, the statements of residents of some of the localities which suffered most from the ravages of the gypsy moth are presented as an appendix to this report. These are selected from among sixty or more such statements in the possession of the committee.

A mass of information regarding the habits and natural history of the insect has been obtained by the advising entomologist and by the director and his assistants. Many valuable facts regarding insect life are continually being observed, and extensive experiments in the use of insecticides have been made. A great variety of plans for dealing with the gypsy moth have been tried. Various appliances have been invented for the economical and effective carrying out of these plans. A full and complete record of all these matters, comprising hundreds of closely written pages, has been preserved in the office of the committee. Our advisory entomologist recommends that this matter be carefully examined and all new scientific or practical information and discoveries sifted out, edited and printed, for the benefit of agriculturists and of entomological science. The principal entomologists of the country have repeatedly, by letter and personal appeal, urged that this be done. The committee has no authority to use the appropriation for such purposes, and would suggest that a specific appropriation of $2,000 for this purpose would enable them to have this matter arranged and edited in the proper form for printing, and would also provide means for following out some scientific experiments and observations that have been discontinued because not directly in the line of extermination. This material would not probably be made ready before near the end of the year, and provisions for printing it may well be deferred till next year.

The reports of Prof. C. H. Fernald, entomological advisor to the committee, and of Edward H. Forbush, director of the field work, are presented herewith as part of the report, and the committee refers to these reports for details of the work.

The following is the financial report for 1893 of the gypsy moth department of the State Board of Agriculture. It will be noticed that a large sum is reported as balance on hand. The work of the committee for the past year has been planned to avoid the annoyance caused by the exhaustion of the old appropriation before a new one is available.

| | |
|---|---|
| Balance on hand Jan. 1, 1893, | $5,672 17 |
| Appropriation, | 100,000 00 |
| | $105,672 17 |

EXPENDITURES.

| | |
|---|---|
| Wm. R. Sessions, expenses, | $9 79 |
| N. S. Shaler, expenses, | 43 00 |
| Francis H. Appleton, expenses, | 41 43 |
| E. W. Wood, expenses, | 16 06 |
| C. H. Fernald, expenses and remuneration, | 730 16 |
| E. H. Forbush, director, salary, | 2,400 00 |
| Book-keeper and clerks in office, | 2,165 32 |
| Travelling expenses of director and men, | 1,414 24 |
| Teaming, livery and board of director's horse, | 1,888 37 |
| Wages of men, | 56,874 33 |
| Rent of storehouse and office, | 297 00 |
| Supplies, tools and insecticides, | 10,047 78 |
| Balance on hand Jan. 1, 1894, | 29,744 69 |
| | $105,672 17 |

WM. R. SESSIONS,
N. S. SHALER,
FRANCIS H. APPLETON,
E. W. WOOD,
WM. H. BOWKER,

*Committee of the Board of Agriculture in Charge of the Gypsy Moth Work.*

## APPENDIX.

### *Copy of Statement of Mr. L. M. Clifford, 32 Myrtle Street, Medford, Mass.*

In 1889 we lost three apple trees because of the caterpillars. They were stripped clean and then leaved out and bloomed again in September. The next spring they leaved out a little, but did not bear, and finally died. In 1889 the caterpillars were over everything. The house was black. They crawled inside of windows whenever they could.

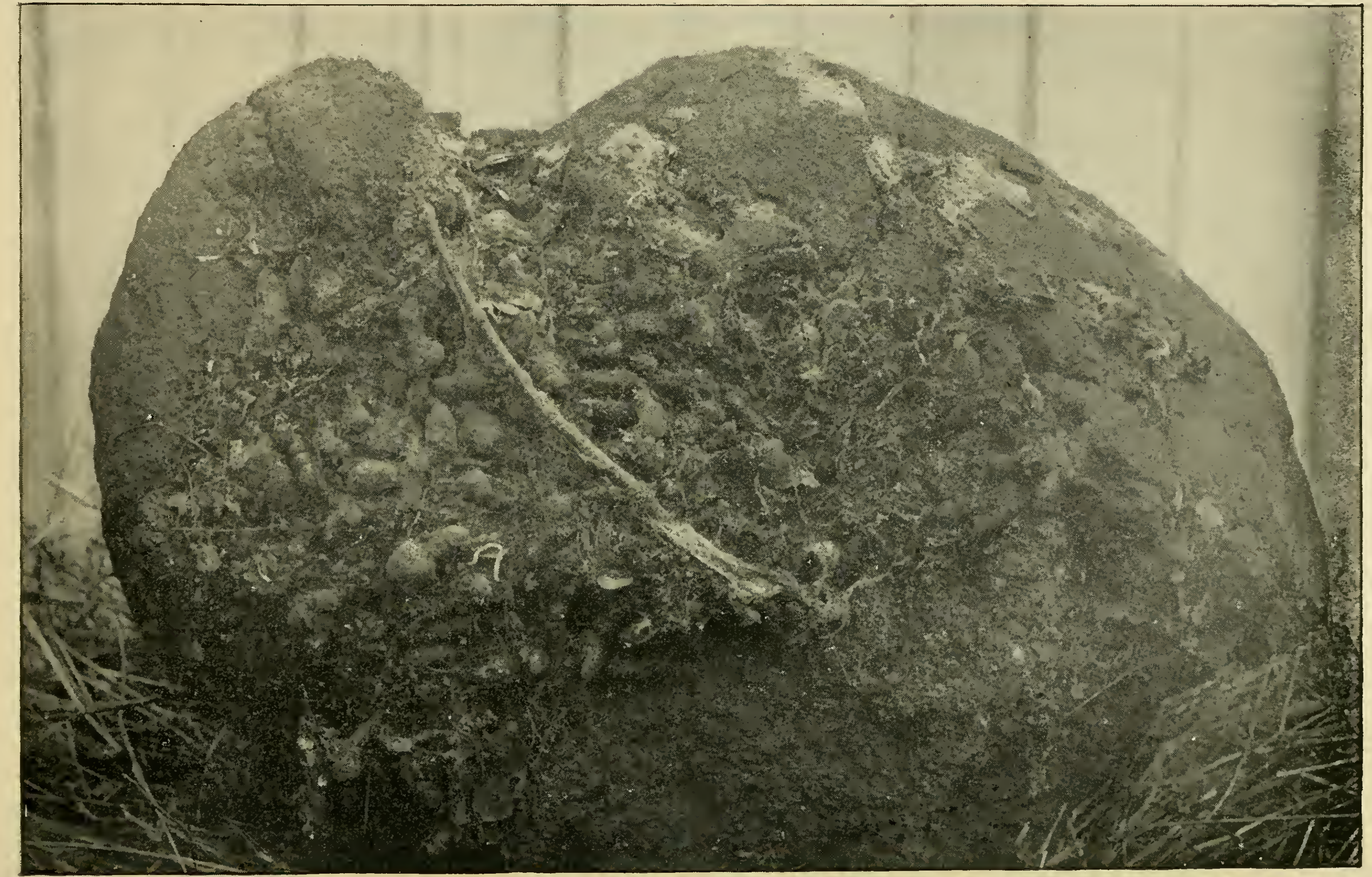
Last year the gypsy-moth men got but one nest from our yard. Last year the caterpillars did no injury to the trees and they bore fairly well. They seemed, however, to have not got over the effects of being stripped two years in succession by the caterpillars and do not bear so well as formerly. One tree in particular, which formerly bore heavily, has never done so well since.

(Signed) L. M. CLIFFORD.

FEB. 11, 1893.

### *Copy of Statement of Mr. J. C. Clark, Station Agent at Park Street, Medford, Mass.*

I live at No. 11 Myrtle Street. The moths ruined me as regards fruit. They were the worst in 1889. Their ravages caused me to lose five nice apple trees, two cherry trees, one pear tree and five plum trees. I lost all my plum trees. One fall I got five bushels of plums from them. The caterpillars stripped these trees of every particle of vegetation. It was the caterpillars, not Paris green, that killed them, because it was before the days of the commission and the trees were not sprayed. The caterpillars did not touch the pear trees until they had eaten all the leaves on the apple trees. I had a crab-apple tree that blossomed very full that spring, but the caterpillars covered it and it died. One of the apple trees which the caterpillars killed was a beautiful Hubbardston. Some years I would get four barrels off of it to put away. All you will see of it to-day in my yard is the stump, over which we train nasturtiums. I would not have taken $100 for the tree. The spring following the ravages of the moth these trees leaved out a little, but not much, and finally died. During the summer of which I speak (1889) my currant bushes were also attacked. They were covered with caterpillars, but I saved them by sprinkling them twice a day with a solution of soap suds and kerosene. The caterpillars covered one side of my house so thickly



A rock with egg clusters and pupæ of the gypsy moth upon it.

Plate V

(From a photograph taken in Malden, Mass.)

that you could not have told what kind of paint was on it. It was impossible to keep them entirely out of the house. The women had to shake their clothing when they went into the house. People used to come from other parts of Medford to Myrtle Street, just to see the ravages of the insect. The State should not drop the work of extermination under any consideration. Myrtle Street has been nicely shaded this year. Only four years ago the trees were bare. The work of the department has been very effective. The men have done great work in our section.

(Signed) J. C. Clark.

Feb. 13, 1893.

*Copy of Statement of Mrs. Wm. Belcher, 29 Myrtle Street, Medford, Mass.*

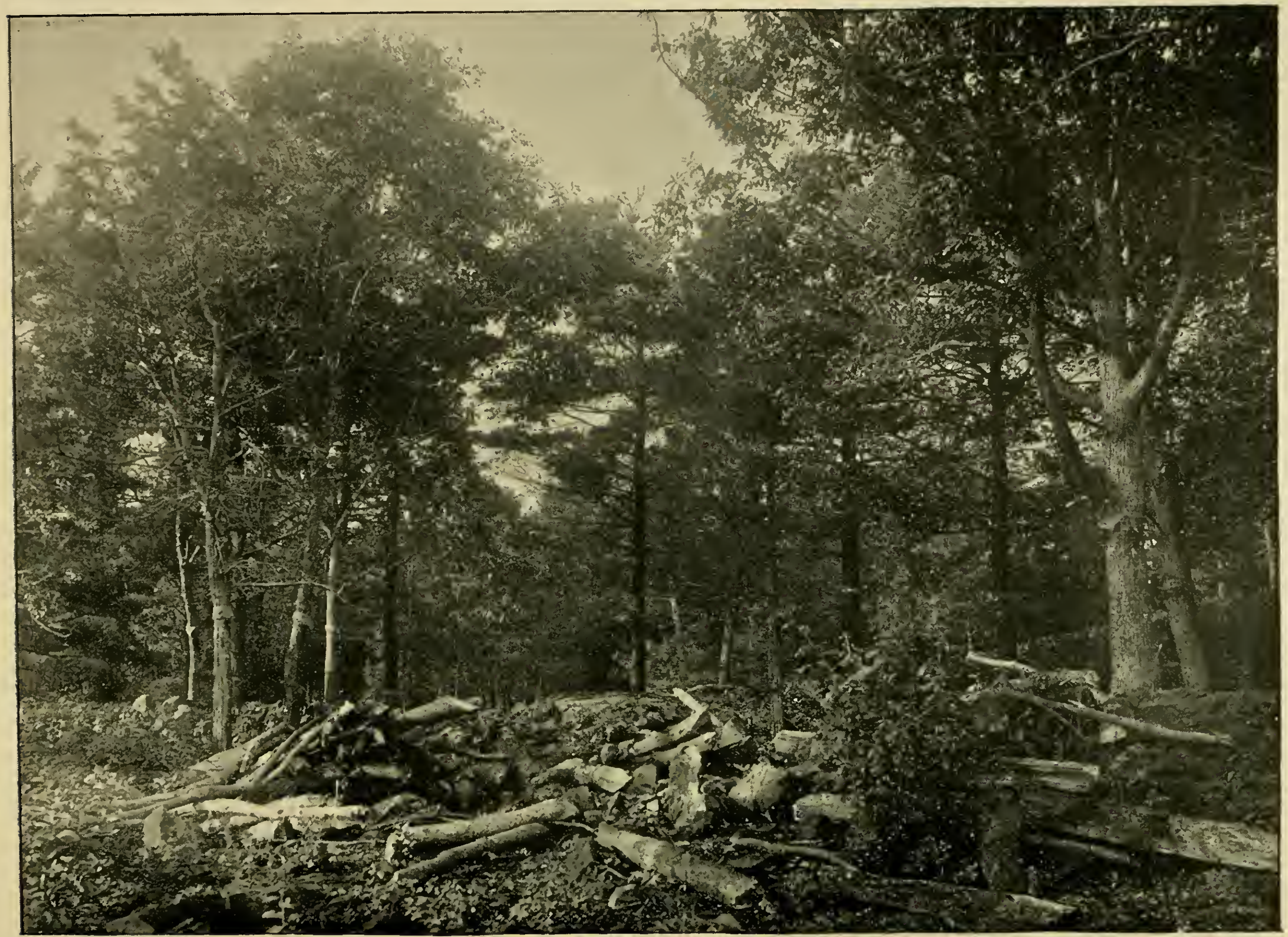
Mr. Trouvelot, who is said to have introduced the gypsy moth into this country, was a next-door neighbor of ours. The caterpillars troubled us for six or eight years before they attained to their greatest destructiveness. This was in 1889. They were all over the outside of the house as well as the trees. All the foliage was eaten off our trees, the apples being attacked first and the pears next. They ate nearly every green thing in my yard, killing my rose bushes and doing much damage to the vegetables. No one who did not see them at that time can form any idea of what a pest they were. They got into the strawberry bed (although they did not eat the leaves), and I used to go out with a dust pan and brush and sweep them up by the panful. It seemed to us absolutely necessary to go out daily and make an effort to at least lessen their numbers. We killed many with boiling hot water and would then dig a hole and bury them so as to prevent a stench. Mr. Belcher was poisoned by them. While killing them upon the trees they would get upon his neck and poison it. It was impossible to stay long in the garden, for they would crawl all over one. We fought them for two or three years before the commission took hold. When they hatched out in the spring our fence would be one living mass. My sister and myself blistered the paint all off the fence with the scalding water that we poured on. When they were small it was almost impossible to keep them off one's person. It is a fact that we have scraped a quart of eggs at a time off the trees. We did the best we could to keep them down, but we could not get them all, for many would hide away and lay their eggs. To show how the caterpillars seem to strike instinctively towards a place where food may be found, my sister cried out one day, "They are marching up the street." I went to the front door, and sure enough, the street was black with them, coming across from our neighbor's, Mrs. Clifford's, and heading straight for our yard. They had stripped her trees, but our trees at that time were only partially eaten.

(Signed) MARY A. BELCHER.

FEB. 13, 1893.

*Copy of Statement of Mr. J. P. Dill, 33 Otis Street, Medford, Mass.*

In the summer of 1889, while living on Park Street, Medford, we were literally overrun with the gypsy-moth caterpillars. We had four large apple trees in our yard, which, although old, were very productive. The caterpillars first appeared on the trees in May and were at their worst in July, when they had got their growth. They ate all the leaves off the trees until it seemed as if fire had run through them. The trees finally became as leafless as in midwinter. The caterpillars began apparently by perforating the leaves and finally ate them all up. After eating the apple-tree leaves they attacked a Bartlett pear tree and completely stripped it of its leaves. We got no fruit from either the pear tree or the apple trees that year. The apple trees, indeed, we cut down later in the season, because there were holes in them, and we knew the caterpillars could never be cleaned out, and consequently did not want to suffer every year from such a pest. That summer we could have got the caterpillars out of the holes in the trees by pecks. After the caterpillars ate all the leaves off the trees they went down into the grass, where they swarmed. When the plague was the worst that summer, I do not exaggerate when I say that there was not a place on the outside of the house where you could put your hand without touching caterpillars. They crawled all over the roof and upon the fence and plank walks. We crushed them under foot on the walks. We went as little as possible out of the side door, which was on the side of the house next to the apple trees, because the caterpillars clustered so thickly on that side of the house. The front door was not quite so bad. We always tapped the screen doors when we opened them, and the monstrous great creatures would fall down, but in a minute or two would crawl up the side of the house again. When the caterpillars were the thickest on the trees we could plainly hear the noise of their nibbling at night, when all was still. It sounded like pattering of very fine raindrops. If we walked under the trees we got nothing less than a shower bath of caterpillars. We had a hammock hung between the trees that summer, but we could not use it at all. The caterpillars spun down from the trees by hundreds, even when they were of a large size. We had tarred paper around the trees, but they crawled up



View of woodland at Cedar Hill, Swampscott, Mass., taken one year after the moths had been destroyed, the dead trees cut, and the ground burned over.

the trunks in masses and went right over the paper. The bodies of those that got stuck in the printers' ink served as a bridge for their brethren. The caterpillars were so thick on the trees that they were stuck together like cold macaroni. A little later in the season we saw literally thousands of moths fluttering in the back yard. In the fall the nests were stuck all over the street trees. Our four apple trees which we cut down because of the pest yielded the year before eleven or twelve barrels of fine Baldwin apples. I have been told that in other places in Glenwood the caterpillars even ate cabbages and other plants. In the summer of 1892 I noticed very few caterpillars.

(Signed) J. P. Dill.

Medford, Mass., Feb. 11, 1893.

*Copy of Statement of Mrs. S. J. Follansbee, 35 Myrtle Street, Medford, Mass.*

In 1889 the walks, trees and fences in the yard and the sides of the house were covered with caterpillars. I used to sweep them up with a broom and burn them with kerosene, and in half an hour they would be just as bad as ever. There were literally pecks of them. There was not a leaf on my trees. The apple and crab-apple trees were all stripped, and the pears partly so. They even nibbled the young green pears, and I lost a good many in that way. My large cherry tree, which usually bears two bushels, was stripped clean for two years running and I got no fruit. The caterpillars ate all the young tomato vines and injured my rose bushes. The Balm of Gilead trees outside on the street were regular harboring places for the pest. Back of the house and across the railroad track was a large tract of young growth, oaks and maples. They were all stripped. The caterpillars did not leave a leaf. The trunks and branches were covered with their cocoons. The cocoons hung in bunches as big as a pint dipper. The stench in this place was very bad. This tract has since been cleared by the gypsy-moth men. Last year I had no trouble with the caterpillars. I did not see one in the yard all last summer. I picked a bushel and a half of cherries off my tree. For three years previous to 1891 my Baldwin apple tree bore no fruit on account of the ravages of the moth. It was stripped every year. In 1891 the number of caterpillars was so lessened that the trees escaped harm and bore three bushels of splendid apples. The spraying seemed to do the blossoms good. Last fall (1892) I got about two bushels off the tree.

(Signed) S. J. Follansbee.

Feb. 11, 1893.

### *Copy of Statement of Mrs. I. W. Hamlin, corner of Spring and Myrtle Streets, Medford, Mass.*

The gypsy-moth caterpillar became quite prominent in our neighborhood some six years ago. They were at their worst in 1889. One day in June my attention was called to some shade trees on Myrtle Street, the trunks of which were literally black with the caterpillars. Our yard was overrun with caterpillars. For six weeks a great deal of our time was devoted to killing these caterpillars and we did not have half as many as people farther down the street. When they got their growth these caterpillars were bigger than your little finger and would crawl very fast. It seemed as if they would go from here to Park Street in half an hour. We would go out in our yard time after time during the day and gather the caterpillars in dishes. Time and again I have stayed out in the yard for two hours at a time catching caterpillars. But in half an hour afterwards they seemed to be just as thick again. It was a common remark in the house, "Well, it is time to go out and make our rounds again," and then we would sally out with our pans. When the caterpillars were very small we used to kill them with hot water. The big ones we killed by pouring kerosene oil over them and burning them. Our one apple tree was stripped of its leaves for two or three years running. The trees of our next door neighbor, Mr. Randall, suffered very much. The caterpillars got into his evergreens and were so thick that they made them look black. The trees have since died. I do not know whether or not it was owing to the caterpillars. Mr. Randall was on the point of moving to Franklin, but he stayed in Medford two months that summer to fight the moths and save his trees. There were people on Myrtle Street whose geraniums and plants were eaten. Many people took much time to fight the caterpillars and killed a great many. Others would say, "What is the use?" and would do nothing. We were very glad to be relieved of the work by the appointment of the commission. The next spring we found many small ones on our fence, but we killed all that we could before they grew large and so did not suffer from them as in the preceding summer. In some other places, however, they were just as bad. Last summer I do not think I saw three caterpillars on our premises. If the State had not done something I think it would have been overrun by now.

(Signed) MRS. I. W. HAMLIN.

FEB. 13, 1893.

*Copy of Statement of Mr. Wm. B. Harmon, 55 Spring Street, Medford, Mass.*

In the summer of 1890 the caterpillars destroyed all our fruit. They attacked and stripped the apple trees first and then turned their attention to the pear trees, which they also stripped. The young fruit was entirely ruined and we had nothing that fall. The trees in places were actually black with caterpillars. They would collect in great bunches and we would sweep them off with a broom. I had quite a large vegetable garden which was nearly ruined by the caterpillars. They destroyed the cucumbers and ate all the tops off the tomatoes. They also stripped some flowering plants. We could not step out of doors, either on the grass or on the walk, without crushing the caterpillars under foot. Over our front door the house was black with them. We would clear them off every morning, but in an hour it would be black again. People could not come in that way. It is no exaggeration to say that there were pecks of the caterpillars under the doorsteps and on the fence. We had both the fence and the steps split up and burned so as to deprive the pest of its harboring places. I have frequently gathered half a coal-hodful of caterpillars from the fence within a short space of time. In twenty minutes they seemed to be just as thick as ever. We burned many pecks of them in all. The next lot to ours was a vacant brush lot. It actually swarmed with caterpillars, and they came from there into our yard by thousands. Last year (1892) we saw but a few caterpillars.

(Signed) Wm. B. Harmon.

Feb. 11, 1893.

*Copy of Statement of Mr. J. W. Harlow, 58 Spring Street, Medford, Mass.*

We did not suffer so badly from caterpillars in 1890 as some of our neighbors, because we had no fruit trees in our yard. An oak tree in our back yard was stripped nearly bare. Our blackberry and raspberry bushes were badly eaten and we got but little fruit from them that summer. Two oaks on the street in front of our house were entirely stripped. The next year they did not leave out and were cut down. We were not troubled by the caterpillars last summer.

(Signed) J. W. Harlow.

Feb. 11, 1893.

*Copy of Statement of Station Agent E. Clark, Glenwood, Medford, Mass.*

When the caterpillars were thick in Medford a few years ago one would have thought that a fire had run through the gardens. The apple and pear trees were stripped and the fences and walks were covered with caterpillars. The work of the present department in stopping the ravages of the moth has been a success and should be continued by all means.

(Signed) E. Clark,
*Station Agent.*

Feb. 11, 1893.

*Copy of Statement of Mr. A. R. Bunting, Swampscott, Mass.*

The gypsy-moth caterpillars were very thick in the spring of 1892 at the Marshall place, on Humphrey Street. The trees for two or three acres were stripped of their leaves. It looked as if a fire had been through them. There was no more sign of a leaf in May or June than there would be in February.

(Signed) A. R. Bunting.

Swampscott, February, 1893.

## Field Director's Report.

*To the Committee on the Extermination of the Gypsy Moth.*

Gentlemen: — It will be impossible, within the limited space allowed to this report, to describe in detail the work of the season of 1893 and its results. I shall therefore make only a brief statement of the methods employed and the results attained.

### *Methods.*

The methods used in the extermination of the moth during the year 1893 were much the same as those of the previous year, with such modifications and additions as experience has suggested.

Eggs of the moth which had been deposited on trees, buildings and other objects were not removed, but were saturated with creosote oil or burned by a combination of dilute nitric and carbolic acids. Either of these methods insured the speedy destruction of the life of the eggs, which were less likely to be scattered about than if they were scraped from the trees.

The imported "Raupenleim" or "insect lime" was also used in banding large trees to prevent the caterpillars from climbing them, but it did not prove as effectual as in 1892, owing either to its poor quality or an unfavorable season. It was also used as a cement in filling the cavities of infested trees, thereby depriving the caterpillars of their hiding-places, and for this purpose it proved superior to anything heretofore used.

In May bands of burlap were placed around these trees as an artificial hiding-place for the caterpillars, and later a large proportion of them were found under the bands and killed. The burlaps in the outer towns were visited daily and the trees were occasionally looked over, both by the regular men and by special inspectors. This resulted in almost completely eradicating the moth from the outer towns, so that in some towns no eggs were found during the fall.

Owing to the insufficiency of the appropriation and the consequent lack of men, the burlap on the trees in the central towns was not as often visited, but was examined fortnightly, weekly or bi-weekly, as the circumstances admitted or as immediate necessity demanded. As the effectiveness of this method depends largely on daily visits to the bands, the results were not as satisfactory as in the outer towns, but the moths were held in check and considerably reduced in numbers.

As the young caterpillars hatched and appeared in the undergrowth on the borders of woodland they were destroyed by burning over small tracts with crude oil by means of the cyclone burner, first made use of in this work in 1891. This method has proved to be certain destruction to the caterpillars if employed at the right time.

As the season advanced, traps containing artificially reared female moths were placed in the field and the males were attracted to them in considerable numbers. As many of the males emerge from the pupa before the females and are thus captured before they have an opportunity to pair, the number of fertile egg clusters may be lessened in this way at a small expense.

The experiments with insecticides made under Prof. C. H. Fernald's direction have proved conclusively that the arsenites as commonly used for spraying foliage are ineffectual with the gypsy moth. The chemical experiments made at the field director's office by Mr. F. C. Moulton, one of the inspectors employed by the committee, have resulted in the discovery of some insecticide mixtures, one of which seems to be very effective with the gypsy moth and may be useful in exterminating the pest. This consists of a mixture of an arsenite with acetate of lead and glucose in water, and apparently gives the long-sought result.* It is claimed that it is not washed off the leaves by showers, but that it is retained upon them during an entire season. It can be used in sufficient strength to kill the caterpillars of the gypsy moth without injury to the foliage. Enough spraying was done during the season to test this mixture in the field, and it has given the best results that have yet been obtained by spraying.

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* The formula most used was sodic arseniate, 29.93 per cent.; plumbic acetate, 70.07 per cent.

The means which, though expensive, have given the best results, and have finally exterminated the moth from localities and towns, consist of a thorough, long-continued and repeated search by competent men, not only of all known infested localities, but of entire towns. The moth is now so rare in most of the infested towns that it is only by such search that it can be found, and this search must be relied upon to assure extermination.

When a colony is found all forms of the moth must be destroyed; loose bark must be scraped from the trees, the undergrowth cut and burned, all cavities which may serve for hiding places filled, and the locality carefully watched for at least two years.

This method, expensive though it may be, is sure to secure extermination.

### *Means of Preventing Extended Distribution.*

As it was known that the moths were disseminated mainly by carriage driving and teaming from badly infested centres, plans for preventing this distribution were shaped accordingly.

Every effort was made to clear all badly infested localities and trees along the highways.

The inspection of two seasons having established with some certainty the extent of the territory infested, measures were taken to reduce its area: first, by holding the insects in check in the badly infested central towns that they might not spread further; second, by exterminating them in the outer towns which were less infested.

It was also important that an annual search should be made in the towns adjoining the infested district to ascertain whether the moths were being further disseminated.

### *Inspection of Towns Outside the Infested Region.*

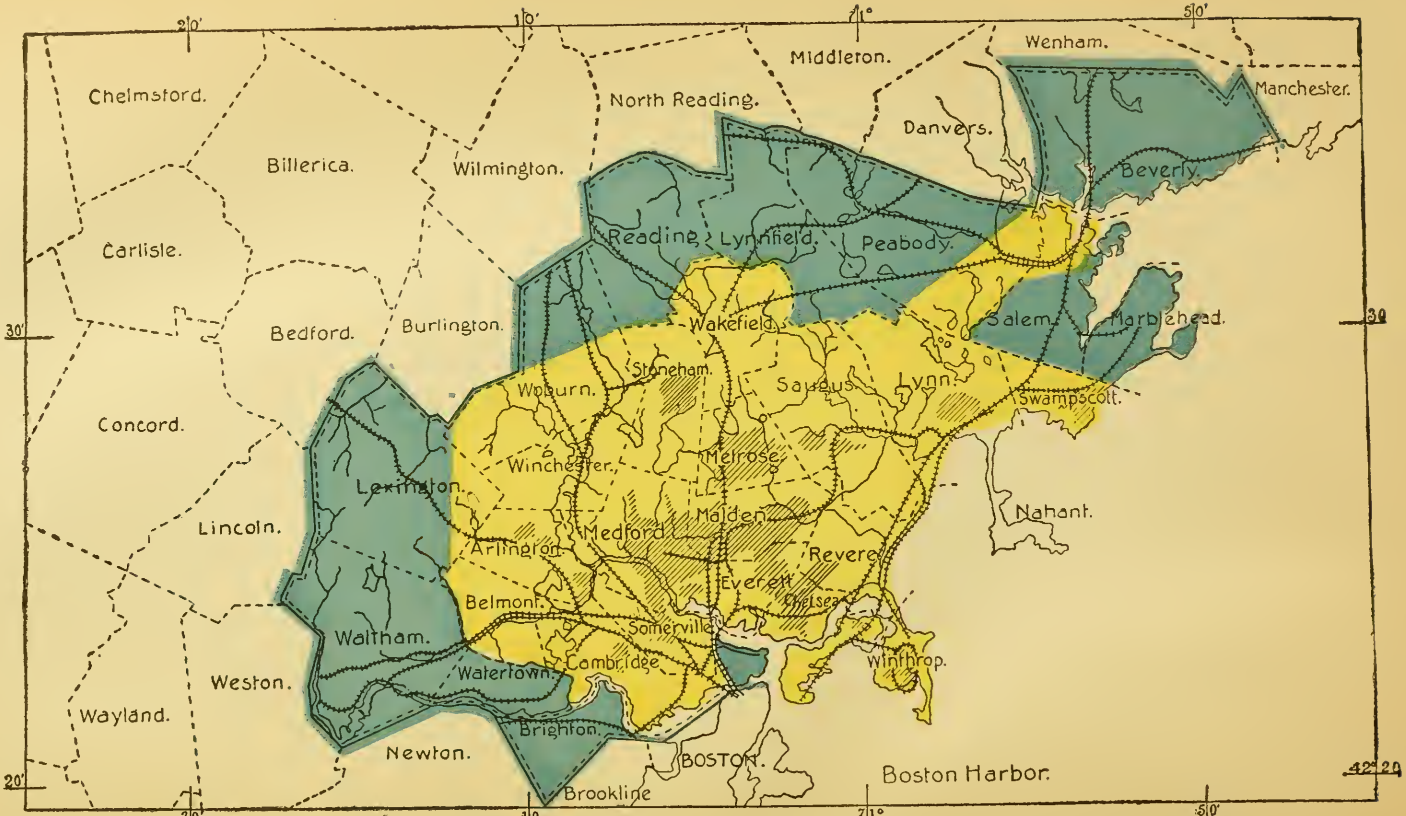
The appropriation made by the Legislature of 1893 allowed the committee to undertake the inspection of the towns in the vicinity of the infested region on a larger scale than had hitherto been possible.

A study of the conditions which have produced isolated moth colonies has made it possible to determine what kind of localities in towns outside the known infested territory were in most danger of becoming infested during the years when the moth was abundant and spreading. In inspecting such towns particular attention has been paid to all places where vehicles from the infested region have frequently stopped, such as hotels, stores, picnic grounds, public parks, the premises of milkmen, peddlers, and of all persons who have travelled regularly in vehicles through the infested region on the way to and from Boston. By a study of the teaming from an infested town it is often possible to determine what places in other towns may have become infested by such teaming.

To illustrate: during 1889, 1890 and 1891 swill was hauled from the almshouse at Cambridge directly under trees which were then badly infested. As a probable result forty-six of the estates in towns to which the swill was transported became infested.

During the spring and summer of 1893 statistics of traffic and travel were gathered and tabulated, and two men, under the direction of Professor Shaler of the committee, were sent out in the region south of Boston with instructions to examine all localities where travel by teams centred. Their search resulted in the discovery of the moth in Franklin Park, Boston's largest public park. The moths appeared to have been established there from three to five years, but (as is usual with isolated colonies) had not spread rapidly. Much work has been done in Franklin Park by the employees of the Board, but it is doubtful whether the moths have yet been exterminated, as the tangle of ornamental vines and shrubbery which underlies the infested trees renders the result of the season's work problematical. The place must be carefully watched to secure extermination.

The railroads running north from the infested region were then followed up by these men as far as the southern portions of Maine and New Hampshire. The trees along the main lines and near stations and sidings were examined, but no moths were found. Eighteen men were also employed in a thorough inspection of the towns contiguous to the in-



Map of the region found infested in 1891. Showing the area from which the moth has been apparently exterminated.

Territory from which the Gypsy Moth has apparently been exterminated, 🟩 Territory still infested Jan. 1, 1894, 🟨

Colonies found outside the known infested region in 1893, -

fested region. In the autumn, as soon as the leaves had fallen, experienced men were sent into the towns lying further west and north, with instructions to visit and inspect all estates named in the statistics obtained during the summer and all other places which during the inspection were found to have been endangered by constant teaming from the infested region. During this search two orchards were found infested in Burlington, one near the Woburn line, the other near the Lexington boundary. These, with the colony in Franklin Park and one found just over the Peabody line in Danvers, early in the season, are the only colonies known outside the region which was found infested during the search of 1891. Every visible vestige of the moth in these places was destroyed.

Every effort possible with the means at hand was made during the season to determine whether the moth had extended beyond its known limits. Many places have been reported as infested by the gypsy moth and all such reports have been investigated, with negative results.

### *Results of the Year's Work.*

During the past year more than one hundred towns outside the infested region have been visited and either partially or wholly inspected, but in them no moths have been found. The following places named in the "list of towns infested in 1891" have been apparently cleared of the moth: Beverly, Brighton, Charlestown, Lynnfield, Marblehead, Reading, Waltham and Watertown.* (See map.) Two other towns (Burlington and Danvers) which have since been found infested, have been thoroughly searched and cleared.

While the formerly infested localities in these towns will not need to be worked as they were in 1893, each town ought to be carefully inspected at least once each year as long as the moths are known to be in the adjacent towns. Most of the known infested localities in Lexington, Peabody, Salem, Swampscott, Woburn, Winchester, Winthrop and Wakefield have been cleared, and another year's work like the last ought to exterminate the moth from these towns. The condition of Lynn is much improved, and that of Belmont, Stoneham and Arlington considerably so. More than eight hundred colonies of the moth, situated mostly in the foregoing towns, have now been exterminated.

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* Two of these (Charlestown and Brighton) must be considered as districts as they comprise certain wards of Boston.

The other towns and cities in the infested region are in somewhat better condition than in 1892, but a much greater improvement might have been made had the appropriation been larger. The district comprising Saugus, Revere, Everett, Chelsea, East Boston, Malden, Medford, Melrose, Somerville and Cambridge was the one necessarily neglected during some parts of the year in order that the work in the other towns might be thoroughly done. This policy was unavoidable through a lack of funds sufficient to keep the whole region under constant inspection. *This necessitates a continual duplication year after year of the work done in these towns and continually defers the final extermination of the moth.*

*Number of Men Employed Each Week.*

| Week Commencing. | Week Ending. | Number of Men. |
|---|---|---|
| Jan. 2, . . . . . | Jan. 7, . . . . . | 30 |
| 9, . . . . . | 14, . . . . . | 28 |
| 16, . . . . . | 21, . . . . . | 28 |
| 23, . . . . . | 28, . . . . . | 27 |
| 29, . . . . . | Feb. 4, . . . . . | 25 |
| Feb. 6, . . . . . | 11, . . . . . | 24 |
| 13, . . . . . | 18, . . . . . | 24 |
| 20, . . . . . | 25, . . . . . | 22 |
| 27, . . . . . | Mar. 4, . . . . . | 25 |
| Mar. 6, . . . . . | 11, . . . . . | 25 |
| 13, . . . . . | 18, . . . . . | 0 |
| 20, . . . . . | 25, . . . . . | 8 |
| 27, . . . . . | Apr. 1, . . . . . | 27 |
| Apr. 3, . . . . . | 8, . . . . . | 44 |
| 10, . . . . . | 15, . . . . . | 93 |
| 17, . . . . . | 22, . . . . . | 115 |
| 24, . . . . . | 29, . . . . . | 125 |
| May 1, . . . . . | May 6, . . . . . | 128 |
| 8, . . . . . | 13, . . . . . | 132 |
| 15, . . . . . | 20, . . . . . | 132 |
| 22, . . . . . | 27, . . . . . | 132 |
| 29, . . . . . | June 3, . . . . . | 131 |
| June 5, . . . . . | 10, . . . . . | 128 |
| 12, . . . . . | 17, . . . . . | 131 |
| 19, . . . . . | 24, . . . . . | 132 |

*Number of Men Employed Each Week* — Concluded.

| Week Commencing. | Week Ending. | Number of Men. |
|---|---|---|
| June 26, | July 1, | 149 |
| July 3, | 8, | 153 |
| 10, | 15, | 154 |
| 17, | 22, | 147 |
| 24, | 29, | 151 |
| 31, | Aug. 5, | 146 |
| Aug. 7, | 12, | 144 |
| 14, | 19, | 126 |
| 21, | 26, | 125 |
| 28, | Sept. 2, | 121 |
| Sept. 4, | 9, | 101 |
| 11, | 16, | 95 |
| 18, | 23, | 93 |
| 25, | 30, | 89 |
| Oct. 2, | Oct. 7, | 86 |
| 9, | 14, | 85 |
| 16, | 21, | 89 |
| 23, | 28, | 88 |
| 30, | Nov. 4, | 88 |
| Nov. 6, | 11, | 88 |
| 13, | 18, | 88 |
| 20, | 25, | 85 |
| 27, | Dec. 2, | 85 |
| Dec. 4, | 9, | 85 |
| 11, | 16, | 86 |
| 18, | 23, | 85 |
| 25, | 30, | 83 |

## *Work Done.*

The statistics given below show mainly the results of searching and hand killing. The figures taken from the report of the work of 1892 are inserted for convenience in comparing them with those of 1893.

| Trees (fruit, shade and forest) : — | 1892. | 1893. |
|---|---|---|
| Inspected, | 2,109,852 | 4,108,494 |
| Found to be infested with caterpillars, pupæ, moths or eggs, | 108,428 | 44,716 |
| Cleared of eggs, | 99,989 | 2,068 |
| Cemented, | 12,172 | 4,583 |
| Banded (insect lime), | 21,251 | 19,453 |
| Burlapped, | 110,108 | 419,434 |
| Sprayed, | 7,372 | 5,145 |
| Trimmed, | 0 | 1,906 |

| | 1892. | 1893. |
|---|---|---|
| Trees (fruit, shade and forest) — *Concluded.* | | |
| Scraped, | 0 | 2,406 |
| Cut, | 395 | 4,055 |
| Acres of brushland and woodland cut and burned over, | 115 | 184 |
| Buildings: — | | |
| Inspected, | 22,102 | 8,828 |
| Found to be infested, | 1,557 | 348 |
| Cleared of eggs, | 1,427 | 232 |
| Wooden fences: — | | |
| Inspected, | 24,936 | 15,092 |
| Found to be infested, | 2,365 | 713 |
| Cleared of eggs, | 2,159 | 541 |
| Stone walls: — | | |
| Inspected, | 2,213 | 814 |
| Found to be infested, | 672 | 225 |
| Cleared of eggs, | 354 | 93 |
| Number of each form of the moth destroyed during the year by hand: — | | |
| Caterpillars, | 935,656 | 1,173,351 |
| Pupæ, | 80,021 | 77,029 |
| Moths, | 9,338 | 5,655 |
| Hatched or infertile egg clusters, | 40,954 | 6,868 |
| Unhatched and probably fertile egg clusters, | 99,790 | 46,101 |

It will be seen that nearly twice as many trees were inspected in 1893 as in 1892. This is accounted for by the fact that a larger number of experienced men were employed in searching the towns along the border of the infested region in 1893, and also that more time was spent during the summer of 1893 in inspecting the trees in these and the central towns.

It will be noticed that the number of trees, walls and fences found infested and the number of egg clusters found in 1893 were much less than in 1892, while the number of caterpillars destroyed was greater. In this connection it should be remembered that the number of trees burlapped during 1893 was nearly four times as great as the number burlapped in 1892, and the number of men employed during the summer of 1893 to inspect them averaged larger than the number employed in 1892. This resulted in a more frequent examination of burlaps and a consequent greater destruction of caterpillars.

Furthermore, in 1893, the men, while engaged in inspecting the great number of burlapped trees in the worst infested towns, occasionally found and killed large numbers of caterpillars upon garden plants and shrubbery where they would otherwise have been overlooked. A few caterpillars found under a burlap sometimes furnished a clew which led to the discovery of many more near by. These greatly swelled the sum total of caterpillars destroyed, though they did not add to the number of trees infested. No accurate account of the number of caterpillars or eggs destroyed by spraying or fire could be kept.

The number of trees, fences and walls infested is in every case larger than the number cleared of eggs. This is accounted for by the fact that these objects were reported infested if any form of the moth was found upon them, but were not reported as cleared unless eggs only were found.

*Non-infested Towns which have been visited by Reason of Complaints received.*

*Massachusetts.*

Ashburnham,
Abington,
Brookfield,
Duxbury,
Dorchester,
Framingham,
Gloucester,
Hudson,
Ipswich,
Lowell,
Lawrence,
Manchester,
Marshfield,
Milford,
Newton,
North Andover,
Pepperell,
Princeton,
Quincy,
Rowley,
Rockport,
Sutton,
Uxbridge,
Weston,
Westborough,
West Newbury,
Wellesley.

*Connecticut.*

Glastonbury.

*Rhode Island.*

Providence.

*New Hampshire.*

Kensington.

*Other Towns and Cities which have been visited and wholly or partially inspected, but have not been found infested.*

*Massachusetts.*

Acton,
Amesbury,
Andover,
Ayer,
Bedford,
Billerica,
Brookline,
Braintree,
Bradford,
Boxford,
Concord,
Canton,
Dedham,
Dorchester,
Essex,
Framingham,
Fitchburg,
Gloucester,
Groveland,
Georgetown,
Hamilton,
Hull,
Hingham,
Haverhill,
Ipswich,
Lincoln,
Lawrence,

### *Massachusetts* — Concluded.

Littleton,
Lowell,
Leominster,
Lunenburg,
Manchester,
Middleton,
Milton,
Newton,
Newbury,
Newburyport,
North Andover,
North Reading,
Quincy,
Rowley,
Randolph,
Stoughton,
Salisbury,
Springfield,
Sudbury,
Sharon,
Shirley,
Tewksbury,
Topsfield,
Wenham,
Wilmington,
Wayland,
Weston,
Wellesley.

## *Stations in Maine and New Hampshire visited in inspecting along the Railways.*

### *Maine.*

Agamenticus,
Biddeford,
Berwick,
Conway Junction,
Eliot,
Kennebunkport,
Kittery,
Kennebunk,
Portland,
Saco,
Scarborough,
Wells.

### *New Hampshire.*

Atkinson,
Durham,
Dover,
Exeter,
Greenland,
Hampton,
Kingston,
Madbury,
Newmarket,
Newton Junction,
Portsmouth,
Powow River,
Plaistow,
Rye Beach,
Rollinsford,
Salmon Falls,
Seabrook,
State Line,
Westville.

## *List of Places formerly infested from which the Moth has been apparently exterminated.*

Beverly,
Brighton
Burlington,
Charlestown,
Danvers,
Lynnfield,
Marblehead,
Reading,
Waltham,
Watertown.

## *List of Cities and Towns still infested.*

Arlington,
Belmont,
Boston,
Cambridge,
Chelsea,
Everett,
Lexington,
Lynn,
Malden,
Medford,
Melrose,
Peabody,
Revere,
Salem,
Swampscott,
Saugus,
Somerville,
Stoneham,
Wakefield,
Winchester,
Winthrop,
Woburn.

### *Why the Moth has not yet been exterminated.*

First. It had been established here for over twenty years; had spread over thirty townships, and had obtained a strong foothold before any organized attempt was made to check it. These facts alone rendered its extermination, even under the most favorable circumstances, a matter of several years' time.

Second. As the extent of its dissemination was not at first accurately determined, the appropriation made by the Legislature proved utterly inadequate.

The appropriations of 1890 and 1891 were made with the understanding that the moth had been found in a few towns only and was confined to cultivated lands. Though this understanding was based on the most reliable information that could then be obtained, later search by the agents of the Board of Agriculture proved that the moth had invaded many towns, and in several of them had penetrated the forested lands.

Third. As the difficulty of extermination has not been and is not now generally appreciated, the expense of the undertaking has been underestimated and the appropriation of 1893 was insufficient.

### *The Difficulty and Expense of Extermination.*

To appreciate the difficulties and uncertainties connected with an attempt to exterminate an imported insect, it must be borne in mind that insects when transported to a new country frequently change their habits to such an extent that new methods of dealing with them must be devised; also, that very little accurate information of the life history and habits of the gypsy moth in this country had been recorded.

It was impossible at first to secure experienced men for the work. It was necessary to select and train the number of men required. And although the advice of some of the most distinguished entomologists of this country was sought, the methods recommended by them as being effectual with native insects proved inadequate for the extermination of the gypsy moth.

Though every effort was made in 1891 to exterminate the moth from the region most infested, the search of 1892 gave abundant evidence of the impossibility of exterminating it in one year's time. Although the greater part of the eggs had been destroyed, caterpillars were found in most parts of the infested territory. It was seen that eggs scattered on the ground and exposed to the elements during winter produced some caterpillars. The eggs are thus frequently scattered by the wind ; by ice forming on the trees ; by people picking fruit or trimming and cutting down trees ; and by various other causes. The female moth often drops a few eggs upon the ground or in the crevices of the bark where they are likely to escape the most thorough search. Such eggs are often fertile. Young caterpillars have been seen to come forth from them in the spring. Though many colonies nevertheless have been exterminated by destroying the eggs, it will be seen how difficult, nay, even impossible, is complete extermination over a large area by this method alone.

It is now a well-known fact that spraying with the arsenical insecticides commonly used is only partially effective with this insect, and such was the prejudice prevailing against this method in some of the infested towns that people frequently washed the trees and shrubbery with water from the garden hose and so neutralized the effect of the spraying.

Bands of insect lime merely prevent the caterpillars from climbing trees which have been first cleared of eggs. But they frequently find means to ascend the trees in spite of the lime bands, and if driven from the trees they will betake themselves to the gardens and shrubbery.

While the burlap bands afford a means of assembling the caterpillars so that they may be easily killed, they cannot all be disposed of in this way, as there seems to be an increasing tendency to avoid the "burlaps," possibly due to natural selection.

### *What Means of Extermination then remain?*

There are certainly two, and possibly three, means which have accomplished the object sought wherever they have been thoroughly applied. Fire can be used either to destroy the eggs of the moth, to kill the caterpillars or to starve them by burning all near-by vegetation on which they feed. This method is feasible only on waste lands.

A thorough, scientifically conducted search for and destruction of eggs, supplemented by burlapping and hand killing, is the only method yet known that can be implicitly relied upon to secure extermination where fire cannot be used.

Work of this kind is necessarily very expensive and the result is uncertain unless it is followed for several years. Many localities are being cleared in this way each year. This sort of work requires experienced and expert men who are intimately acquainted with the localities in which they work and the distribution and history of the moth therein.

If all trees and plants in and near each isolated moth colony could be sprayed with an insecticide which would surely and quickly kill all feeding caterpillars without injury to the foliage, it would be the best plan to pursue in the towns least infested. Such an insecticide seems to have been found. If, however, it should fail to be as effectual in the field as is expected, further chemical experiments must be made to find an effective insecticide.

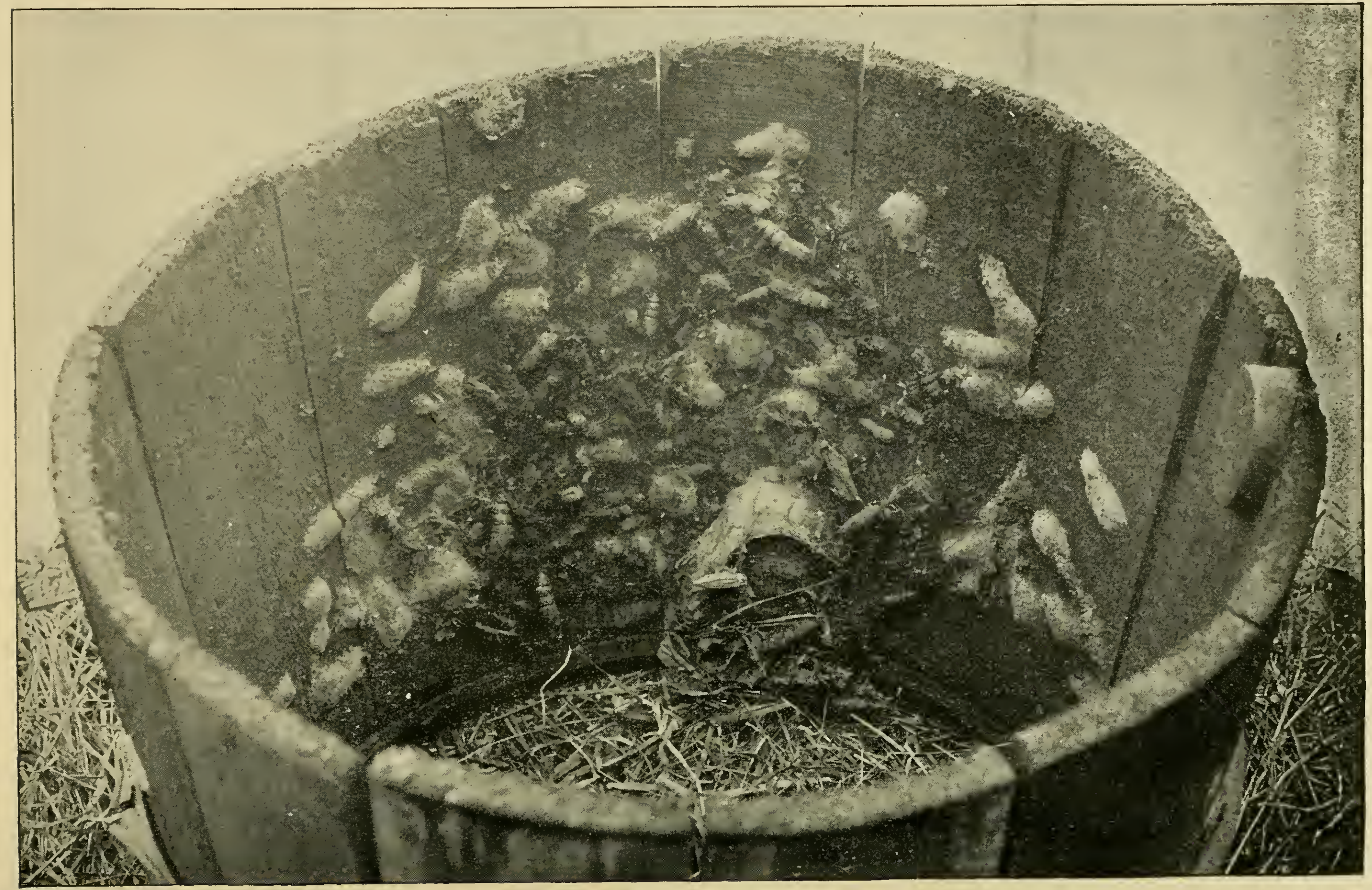
The usual plan of fighting noxious insects is to wait until they begin to do visible damage, and then take means to check them. But with extermination as the object it is a grave error to wait until the moths have become apparent anywhere to common observation — until they have begun to do damage, as in the past, and have scattered to a distance from the worst infested spots. They must instead be at once searched for, found and destroyed. Thousands of infested trees have been marked during the past season on each of which only a single caterpillar, pupa, or egg cluster was found. But these single forms of the moth must be found and destroyed if the insect is to be exterminated.

The statute under which the committee is appointed calls for extermination. The cost of extermination is great. It certainly costs a vast deal more to search for the last egg cluster and the last caterpillar or moth than it would to destroy the majority of them and thus prevent both dissemination and damage for the time being. But if larger sums of money than those already appropriated can be secured, and the extermination of the moth can be accomplished, an expense will be stopped which must otherwise be constantly increasing and which must be borne annually for an indefinite period either by the State or by all residents of the country over which the moth would extend its constantly widening range.

Encouraging progress toward extermination has already been made with manifestly insufficient funds and in the face of many obstacles. The numbers of the moth have been so reduced that no material damage has been done by it during the past two years. It has been exterminated first from single trees, then from orchards, woodlands and entire towns. More than eight hundred infested localities have been entirely freed of its presence. This work was begun on the borders of the infested region and has progressed toward the centre until the moth appears now to have been exterminated from more than one-third of the region infested in 1891.

Respectfully submitted,

E. H. FORBUSH.



Egg clusters and pupæ of the gypsy moth.

## ENTOMOLOGIST'S REPORT.

*To the Committee on the Gypsy Moth.*

GENTLEMEN: — The work of exterminating the gypsy moth has been carried on during the past year with great vigor and success. I have made as frequent visits to the field of operations as my other duties permitted, and have kept in close touch with all the work.

By your direction I invited six of our most prominent entomologists to visit the infested territory, inspect the work and give their impressions and advice. Professor Comstock was unable to do this, but the other gentlemen accepted the invitation, visited the infested region in June, and thoroughly inspected the work in all its departments. I give the following extracts from their reports.

Professor Packard of Brown University says, "I have no adverse criticisms to make. It seems to me that the work is practical and thorough throughout. I saw nothing to find fault with, but much to commend. The new and ingenious devices for spraying, and, in other ways, destroying the eggs and worms interested me very much."

Professor Weed of the New Hampshire Agricultural College says, in his report, "The results already reached seem to me remarkable, and I was greatly surprised at the scarcity of gypsy caterpillars. I found that a series of experiments with remedies was being conducted under the most careful conditions; in fact I have never seen a series of similar experiments carried on in so large a scale, in so thoroughly scientific a manner."

Dr. Fernald of the Pennsylvania State College says, "A careful consideration of the methods used and of the results already obtained has convinced me that the extermination of the gypsy moth is not only possible but certain, if the work be prosecuted for a sufficient length of time. It is to be feared, however, that the apparent disappearance of the moth may lead the Legislature into the error of abolishing the work at a time when it shows the fewest results, but will, in reality, be the most valuable; in fact, would be absolutely necessary to ensure the prevention of some future invasion."

Professor Smith of Rutgers College, after speaking in terms of commendation of the work, experiments, etc., says, "The force under the direction of Mr. Forbush has accomplished wonders, and I feel that there is very good reason for the belief that the gypsy moth can be exterminated, provided the means are furnished by the Legislature of Massachusetts, in as liberal a spirit at least as past appropriations have been made."

Professor Lintner, State Entomologist of New York, says, "I was not prepared to see that such progress had been made towards the extermination of the notorious gypsy moth. It was a surprise to me that, in the brief space of three years, the fearful ravages of the insect, as described to me and as pictured in photographs, could have been reduced to such an extent that to the ordinary observer no indication of its presence was visible, and that in a ride of an entire day through several of the infested towns, including a visit to localities that had been frightfully scourged, not a single example of the caterpillar was found by me, although diligent search for it was made. How a work of such magnitude, extending over so large a territory, could have been accomplished was a wonder and an enigma to me, until I became acquainted with the means by which it had been brought about. I trust that your Legislature will see the wisdom of continuing the work under suitable appropriations, until the extermination of the insect has been attained."

The above named gentlemen all expressed themselves very strongly in favor of the continuation of the work to the complete extermination of this insect, which is sure to prove so exceedingly destructive if it be left to itself.

It has been a greater surprise to me than to any one else, perhaps, to see what has been accomplished from the first; for few persons, if any, have followed and watched the work more closely than I have been able to do from the time the presence of the insects was reported. Only those who have thus carefully and frequently inspected the work can fully realize how much has been accomplished.

During the past season I have had a large number of experiments performed with various insecticides, for the purpose of determining what substances would prove the most successful in destroying the caterpillars, and at the same time the least injurious to the foliage. Experiments with Paris green, repeated each year since the work began, have shown that this substance, in any proportion that will not greatly injure the foliage, will not destroy all the caterpillars when small and only a small proportion of them when more than half grown.

The insecticides used in the experiments referred to were Paris green, Paris green and lime, London purple and acetate of lead, Malden white, Moulton's insectine, woodbine kennel mixture, antinonnin, gypsine. This last substance proved by far the most satisfactory, since it was in no way injurious to the foliage even when used in so large a proportion as twenty-five pounds to one hundred and fifty gallons of water, and it also proved very destructive to the caterpillars. Antinonnin was not received until late in the season, and therefore the experiments with it were not conclusive. There can be no doubt that gypsine will prove far more valuable in destroying the gypsy moth than any of the insecticides in common use, because it can be used in such large proportions as to prove fatal to the insect.

In my report last year I gave a list of four species of insects found destroying the eggs of the gypsy moth, and nine species of true parasites living within and destroying the caterpillars. To this number should be added *Pimpla pedalis* Say., which was omitted from the list last year, by an oversight and *Pimpla tenuicornis* Cress., which has been bred from the gypsy moth this year, thus making a list of eleven different species of true parasites which live within the caterpillar, but which do not emerge until after it changes to a pupa and is dead. There can be no doubt that still other species will be found to attack the gypsy moth in this country. Mr. L. O. Howard, a most excellent authority in such matters, estimates that there are only fourteen undoubted hymenopterous primary parasites on the gypsy moth in Europe, one of which, *Apanteles glomeratus*, already occurs in this country, but it has not as yet been observed preying on the gypsy moth.

Respectfully submitted,

C. H. FERNALD.

## REPORT OF THE GYPSY MOTH COMMITTEE OF THE STATE BOARD OF AGRICULTURE TO THE HOUSE OF REPRESENTATIVES,

### UNDER THE ORDER OF JAN. 15, 1894.

On Jan. 15, 1894, after the Gypsy Moth Committee had submitted its annual report to the Legislature, the House of Representatives adopted the following Order: —

*Ordered*, That the State Board of Agriculture be instructed to report in writing to the General Court on or before the first day of February next the following facts and estimates relative to the work of exterminating the gypsy moth: —

1. The amount appropriated and amount expended annually for such purpose since the work began.
2. The amount per year which, in the estimation of said board, it will be necessary to expend upon such work during the next ten years.
3. Whether, in the estimation of said board, it will be necessary to continue the work of extermination for an indefinite period.
4. If it will not be necessary to continue said work for an indefinite period, what is the probable limit of time during which it will be necessary to continue said work, and what will be the probable necessary expenditure therefor, in the aggregate, after the expiration of ten years from date.

*To the Senate and House of Representatives of the Commonwealth of Massachusetts.*

In response to an order of the Legislature, under date of Jan. 15, 1894, the State Board of Agriculture, by its Gypsy Moth Committee, presents the following "facts and estimates relative to the work of exterminating the gypsy moth." The amounts of appropriations and expenditures have been reported in the several annual reports of the committee, and a summary of the same appears in the report of the work of 1893, now in the hands of the Legislature. The original bills and pay-rolls, showing the details of all expenditures, may be found in the office of the State Auditor in the State House.

The following is a condensed account of the appropriations made and the amounts expended annually: —

### Appropriations.

| | |
|---|---|
| March 14, 1890, | $25,000 00 |
| June 3, 1890, | 25,000 00 |
| June 3, 1891, | 50,000 00 |
| March 1, 1892, | 75,000 00 |
| April 12, 1893, | 100,000 00 |
| Total appropriated, | $275,000 00 |

### Expended in 1890 by First Commission.

| | | |
|---|---|---|
| Salary of commissioners, | $3,118 27 | |
| Wages of employees, | 15,278 32 | |
| Other expenses, | 7,142 73 | |
| Total expended in 1890, | | $25,539 32 |

### Expended in 1891 by Second Commission.

| | | | |
|---|---|---|---|
| Balance of salaries due members of first commission, | $630 95 | | |
| Salary of director, one and one-half months, | 300 00 | | |
| Wages of employees, | 10,147 97 | | |
| Other expenses, including travelling expenses, teaming, rent, supplies and tools, | 2,378 54 | | |
| | | $13,457 46 | |

### Expended in 1891 by the State Board of Agriculture.

| | | | |
|---|---|---|---|
| Expenses of committee in charge of the work, | $121 53 | | |
| Director's salary, seven and one-half months, | 1,500 00 | | |
| Advising entomologist's salary and expenses, | 280 84 | | |
| Wages of employees, | 41,096 86 | | |
| Other expenses, including travelling expenses, teaming, rent, supplies and tools, | 12,790 86 | | |
| | | 55,790 09 | |
| Total expended in 1891, | | | 69,247 55 |

### Expended in 1892 by the State Board of Agriculture.

| | | |
|---|---|---|
| Expenses of the committee in charge of the work, | $130 49 | |
| Director's salary, | 2,400 00 | |
| Advising entomologist's salary and expenses, | 525 60 | |
| Wages of employees, | 59,505 03 | |
| Other expenses, including travelling expenses, teaming, rent, supplies and tools, | 11,979 84 | |
| | | 74,540 96 |
| *Amount carried forward,* | | $169,327 83 |

| | | |
|---|---|---|
| *Amount brought forward,* | | $169,327 83 |

EXPENDED IN 1893 BY THE STATE BOARD OF AGRICULTURE.

| | | |
|---|---|---|
| Expenses of committee in charge of the work, | $110 28 | |
| Director's salary, | 2,400 00 | |
| Advising entomologist's salary and expenses, | 730 16 | |
| Wages of employees, | 59,039 65 | |
| Other expenses, including travelling expenses, teaming, rent, supplies and tools, | 13,647 39 | |
| | | 75,927 48 |
| Total expended to Jan. 1, 1894, | | $245,255 31 |

The estimates called for must, from the nature of the attending circumstances, be only opinions. The plans for the work of 1893, for which an appropriation of $165,000 was asked, contemplated a careful tree-to-tree search of all the forest land within the infested territory. This search would have cost a very large sum; but as only sixty per cent of the sum asked was appropriated, this, with much other work planned for the central district, was necessarily postponed. It was decided that the work of extermination in the outer infested towns and the inspection of the territory surrounding them still further out was most necessary and would contribute most toward extermination. Were the uncertainties that confront us in the condition of these forest lands eliminated, our opinions would more nearly approximate to the character of estimates made by experts when all the conditions of a problem are known.

In 1893 considerable progress toward extermination was made. Ten towns were apparently cleared, comprising more than one-third of the territory originally infested. In 1894, with the appropriation asked for ($165,000), the committee ought to be able to bring into the same category Swampscott, Salem, Peabody, Wakefield, Woburn, Lexington, Winthrop and Franklin Park. This would leave Belmont, Arlington, Cambridge, Chelsea, East Boston, Everett, Lynn, Malden, Medford, Melrose, Revere, Saugus, Somerville, Stoneham and Winchester still infested. Several of these towns should be very nearly or quite cleared in 1894. But we have, in our estimates, left them with the list of probably uncleared. If, in 1895, $150,000 is appropriated, the work of that year should clear all towns but

Arlington, Chelsea, Everett, Malden, Medford, Melrose, Revere, Saugus and Somerville. The moth in these towns should be brought to the verge of extermination so that, with an appropriation of $100,000, the work of 1896 would be quite likely to bring them very near to the condition of the cleared towns. During all this time a large amount of this money must be expended in closely inspecting the towns supposed to be cleared. In 1897 an appropriation of $50,000 would be necessary to provide for the completion of the work in the last-mentioned towns and for the necessary careful reinspection of the whole territory. We think this appropriation would also provide means to stamp out any possible remains of colonies supposed to be exterminated that might be found by the careful reinspection. For the five succeeding years we believe that an average annual appropriation of $25,000 would be necessary to continue the careful inspection of the whole territory and provide the means to deal with any colonies that may possibly have been overlooked. While it is our opinion that it is quite possible to exterminate the moth if large appropriations, such as have been mentioned, are granted for the next few years, we believe it also probable that should an appropriation of only $50,000 per year be granted the work would have to be continued indefinitely, as a very large proportion of such an appropriation would necessarily be expended in watching the outside territory and taking measures to prevent the spreading of the insect.

Another method of estimating the probable future cost of extermination would be to multiply the average cost of extermination per estate in the towns already cleared by the number of estates still infested. We estimate the number of estates still infested at eight thousand. Our records show that the average cost of extermination, per estate, in the towns cleared has been $41.10. At the same rate, the cost of exterminating the moth from eight thousand estates would be $328,800. This statement is made on the assumption that the estates yet infested are now in no worse condition than were those which have been cleared. This computation does not include the large sum which must necessarily be expended in inspecting territory already cleared, that outside which must be watched, and the cost of reinspection for several years of these eight thousand estates after extermination is believed to have been accomplished.

In the opinion of the committee the above-mentioned estimates afford the closest approximation to a forecast that can well be made. It is proper, however, to state that the questions asked by the Legislature cannot be answered with certainty.

Respectfully submitted,
Per order of the Gypsy Moth Committee
of the State Board of Agriculture,

WM. R. SESSIONS,
*Chairman.*

JAN. 29, 1894.

# FINANCIAL RETURNS

AND

# ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

# INCORPORATED SOCIETIES,

WITH MEMBERSHIP AND INSTITUTES
FOR THE YEAR 1893.

# RETURNS OF SOCIETIES.

## AMESBURY AND SALISBURY AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1881, Acts of 1881, chapter 204.

Originally raised by contribution $1,002.32; now has $7,474.62 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $7,474.62: real estate, $7,273.18; crockery, tables, etc., $201.44. Total liabilities, $2,253.49: outstanding bills, $74.13; notes, $2,179.36. Receipts in 1893, $3,699.62: bounty, $600; notes given, $1,200; new members, $112; donations, $139.80; other sources, $1,647.82. Expenditures in 1893, $4,131.59: premiums and gratuities paid, $855.35; current running expenses, $120.74; interest, $78; other expenses, $3,078.40. The society offered in premiums $1,500 and awarded and paid in premiums and gratuities $855.35, which went to 14 cities and towns. Sixty-one dollars and thirty-five cents went to 6 towns outside the State. Two hundred and eighty-eight persons received premiums and 165 gratuities. Under head of farms $34 was awarded and paid; under farm and pet stock $381 was awarded and paid; under field and experimental crops $18 was awarded and paid; under farm and garden products $136.55 was awarded and paid; under dairy products $3 25 was awarded and paid; under domestic manufactures $152.20 was awarded and paid; under agricultural implements $2 was awarded and paid; under objects strictly agricultural, not specified, $15 was awarded and paid; under objects other than agricultural, not specified, $113 35 was awarded and paid. The society reports 204 members, — 187 males and 17 females. Three farmers' institutes were held at Amesbury: January 12, on "Market Gardening;" February 15, on "How to make small farms pay" and "A trip to California;" and April 7, on "Road building."

## ATTLEBOROUGH AGRICULTURAL ASSOCIATION.

Incorporated 1887, Acts of 1887, chapter 203.

Originally raised by contribution $20,000, which is now invested as a capital stock in land, buildings, furniture, fixtures, etc. Total assets, $25,526.79: real estate, $24,500; crockery, tables, etc., $500; cash, $526.79. Total liabilities, $8,036.86: premiums unpaid, $53.95; outstanding bills, $482.91; mortgages or like liabilities, $7,500. Receipts in 1893, $12,342.39: bounty, $600; donations, $57.20; other sources, $11,685.19. Expenditures in 1893, $11,774 35: premiums and gratuities paid, $1,732.20; current running expenses, $350; interest and note, $6,988.08; other expenses, $2,704.07. The association offered $2,610.70 in premiums, awarded $1,786.15 in premiums and gratuities, and paid $1,732.20, which went to 29 cities and towns. Two hundred and twenty-three dollars and sixty-five cents went to 13 cities and towns outside the State. Three hundred and thirty-seven persons received premiums and gratuities. Under head of farm and pet stock $506.75 was awarded and $483.75 paid; under field and experimental crops $20 was awarded and paid; under farm and garden products $203.05 was awarded and $188.85 paid; under dairy products $6 was awarded and paid; under domestic manufactures $193.60 was awarded and $176.20 paid; under agricultural implements $10 was awarded and paid; under bicycle races $100 was awarded and paid; under firemen's contests $390 was awarded and paid; under goat races $15 was awarded and paid; under trotting $758.75 was awarded and paid; under objects other than agricultural, not specified, $88 was awarded and $85.25 paid. The association reports 106 members, — 98 males and 8 females. Three farmers' institutes were held: at Attleborough, January 11, on "The horse of to-morrow: where shall we find it?" at Attleborough, February 28, on "How to make small farms pay;" at Franklin, April 26, on "Plant food."

## BARNSTABLE COUNTY AGRICULTURAL SOCIETY.

Incorporated 1844, Acts of 1844, chapter 114.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $1,740; now has $8,300 invested as a capital stock in real estate and bonds. Total assets, $8,454.59: real estate, $7,500; bonds, $800; cash, $154.59. Total liabilities consist of mortgages or like liabilities amounting to $3,175. Receipts in 1893, $3,914.73: bounty, $600; bonds, $38; new members, $15; donations, $218.30; other sources, $3,043.43. Expenditures in 1893, $3,760.14: premiums and gratuities paid, $1,375; current running expenses, $1,306.88; interest, $195.50; other expenses, $882.76. The society offered $1,125.65 in premiums, and awarded and paid $1,375 in premiums and gratuities, which went to 10 cities and towns. Three hundred and fifty-three persons received premiums and gratuities. Under head of farms $23 was awarded and paid; under farm and pet stock $372.40 was awarded and paid; under field and experimental crops $32 was awarded and paid; under farm and garden products $150.50 was awarded and paid; under dairy products $7 was awarded and paid; under domestic manufactures $135.60 was awarded and paid; under agricultural implements $1 was awarded and paid; under trotting $600 was awarded and paid; under objects other than agricultural, not specified, $18.50 was awarded and paid. The society reports 611 members, — 368 males and 243 females. Three farmers' institutes were held: at Hyannis, January 12, on "Foreign market for cranberries;" at Barnstable, February 23, on "How to make small farms pay;" at Barnstable, November 25, on "What shall farmers have for roads, to get their crops to market?"

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## BAY STATE AGRICULTURAL SOCIETY.

Incorporated 1886, General Laws.

The society in its first report (1888) stated the amount raised by contribution to be at that time $2,177.16; now has $173.73 in cash on hand. Expenditure in 1893, for cooking schools, which were held at Amherst, Athol, Montague, North Andover, Sherborn, Warren and West Newbury, $169.75. The society held no fair in 1893.

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## BERKSHIRE AGRICULTURAL SOCIETY.

Incorporated 1811, Acts of 1811, chapter 70.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $3,000; now has $15,000 invested as a capital stock in real estate. Total assets, $15,326.16: real estate, $15,000; bills due and unpaid, $279; cash, $47.16. Total liabilities, $9,766.95: premiums due and unpaid, $275; outstanding bills, $1,491.95; mortgages or like liabilities, $8,000. Receipts in 1893, $5,591.59: bounty, $600; donations, $100; other sources, $4,891.59. Expenditures in 1893, $5,857.30: premiums paid, $2,738.37; current running expenses, $2,204.58; interest, $480; other expenses, $434.35. The society offered $4,038 in premiums, awarded $3,013.37, and paid $2,738.37, which went to 23 cities and towns. Forty-six dollars was awarded to parties outside the State. Three hundred and forty-six persons received premiums. Under the head of farms $36 was awarded and $33 paid; under farm and pet stock $810.50 was awarded and $659 paid; under farm and garden products $309 was awarded and $224.50 paid; under dairy products $28 was awarded and paid; under domestic manufactures $213.75 was awarded and $202.75 paid; under agricultural implements $65 was awarded and paid; under objects other than agricultural, not specified, $176.50 was awarded and paid. The society reports 1,139 members, — 1,029 males and 110 females. Three farmers' institutes were held: at Pittsfield, April 19, "The horse for to-morrow: where shall we find it?" at Lee, December 1, on "Poultry for profit;" at Dalton, December 2, on "Pork and pork products."

## BLACKSTONE VALLEY AGRICULTURAL SOCIETY.

Incorporated 1884, Acts of 1884, chapter 48.

Originally raised by contribution $3,000; now has $4,500 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $4,577.41: real estate, $4,400; crockery, tables, etc., $100; cash $77.41. Total liabilities consist of mortgages or like liabilities to the amount of $1,200. Receipts in 1893, $1,556.12: bounty, $600; new members, $35; donations, $44.27; other sources, $876.85. Expenditures in 1893, $2,933.22: premiums and gratuities paid, $870.17; current running expenses, $934.35; improvements, $1,128.70. The society offered in premiums $1,178.05, awarded $870.17 in premiums and gratuities and paid $790.27, which went to 17 cities and towns. Eight dollars and seventy-five cents went to two cities outside the State. One hundred and fifty-seven persons received premiums and 15 gratuities. Under head of farms $103 was awarded and $101 paid; under farm and pet stock $564.50 was awarded and $555.50 paid; under field and experimental crops $38.50 was awarded and $31.50 paid; under farm and garden products $91.70 was awarded and $87 paid; under dairy products $6 was awarded and paid; under domestic manufactures $29.50 was awarded and $27 paid; under objects other than agricultural $69.10 was awarded and $65 paid. The society reports 462 members, — 272 males and 190 females. Three farmers' institutes were held: at Uxbridge, January 4, on "Practical agriculture;" at Uxbridge, January 20, on "Practical fruit culture on New England farms;" at Mendon, March 29, on "The use of manures and fertilizers."

## BRISTOL COUNTY AGRICULTURAL SOCIETY.

Incorporated 1823, Acts of 1823, chapter 32.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $3,240; now has $32,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $32,091.21: real estate, $31,800; crockery, tables, etc., $200; bills due and unpaid,

$16; cash, $75.21. Total liabilities consist of mortgages or like liabilities to the amount of $16,000. Receipts in 1893, $17,788.60: bounty, $600; new members, $160; other sources, $17,028.60. Expenditures in 1893, $18,615.55: premiums and gratuities paid, $4,197.95; current running expenses, $640.50; interest, $1,021.50; other expenses, $12,755.60. The society offered $4,919.40 in premiums, awarded $4,345.42 in premiums and gratuities and paid $4,197.95, which went to 26 cities and towns. Forty-nine dollars and fifty cents went to 4 cities and towns outside the State. Eight hundred and eleven persons received premiums and 43 gratuities. Under head of farms $60 was awarded and paid; under farm and pet stock $928 was awarded and paid; under field and experimental crops $62.25 was awarded and paid; under farm and garden products $233 was awarded and paid; under dairy products $38 was awarded and paid; under domestic manufactures $315.27 was awarded and paid; under trotting $2,150 was awarded and paid; under objects other than agricultural, not specified, $423 was awarded and paid. The society reports 895 members, — 695 males and 200 females. Three farmers' institutes were held: at Taunton, January 10, on "Poultry and how to make it profitable" and "The horse for to-morrow: where shall we find it?" at Dighton, March 3, on "Botany of the farm and fungous diseases of plants" and "Our fruits and the insects attacking them;" at New Bedford, March 24, on "Injurious insects and their remedies."

## DEERFIELD VALLEY AGRICULTURAL SOCIETY.

Incorporated 1871, Acts of 1871, chapter 208.

Originally raised by contribution $4,094.01; now has $9,200 invested as a capital stock in real estate. Total assets, $9,505: real estate, $9,200; crockery, tables, etc., $250; cash, $55. Liabilities consist of a note for $1,075. Receipts for 1893, $2,062.69: bounty, $600; new members, $105; donations, $14.25; other sources, $1,343.44. Expenditures for 1893, $2,007.69: premiums paid, $870.05; current running expenses, $772.14; interest, $44.50; other expenses, $321. The society offered in premiums $1,111.50, awarded $870.05 and paid $855.80, which went to 26 cities and towns. Four dollars and fifty cents went to 2 towns outside the State. Two hundred and fifty-two persons received premiums. Under head of farm and pet stock $564.25 was awarded and $557.25 paid; under farm and garden products $71.40 was awarded and $68.90 paid; under dairy products $13 was awarded and $11 paid; under domestic manufactures $87.40 was awarded and $84.90 paid; under trotting $90 was awarded and paid; under objects other than agricultural, not specified, $44 was awarded and $43.75 paid. The society reports 1,329 members, — 1,221 males and 108 females. Three farmers' institutes were held: at Shelburne Falls, January 25, on "Dairying;" at Ashfield, February 24, on "Insect pests;" at Charlemont, March 18, on "Country roads" and "What crops shall we raise the coming year?"

## EASTERN HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 156.

Originally raised by contribution $3,000; now has $7,000 invested as a capital stock in real estate. Total assets, $7,085.83: real estate, $7,000; cash, $85.83. Total liabilities consist of a note for $2,535. Receipts in 1893, $2,320.76: bounty, $600; new members, $15; donations, $36.32; all other sources, $1,669.44. Expenditures in 1893, $2,320.76: premiums and gratuities paid, $1,289.55; current running expenses, $677.58; interest, $142.80; other expenses, $125. The society offered in premiums $1,592.80, and awarded and paid $1,289.55 in premiums and gratuities, which went to 17 cities and towns. One hundred and thirty-seven persons received premiums and gratuities. Under head of farms $10 was awarded and paid; under farm and pet stock $424 was awarded and paid; under farm and garden products $99 was awarded and paid; under dairy products $11 was awarded and paid; under domestic manufactures $61.05 was awarded and paid; under trotting $662 was awarded and paid; under objects other than agricultural, not specified, $26.50 was awarded and paid. The society reports 461 members, — 260 males and 201 females. Three farmers' institutes were held at Palmer: January 12, on "The horse;" February 14, on "Small fruits and flowers;" March 10, on "The work of the Board of Agriculture" and "Roads."

## ESSEX AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 25.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $9,363.66; now has $21,966 invested as a capital stock in real estate, stocks, bonds, crockery, tables, etc. Total assets, $19,533.05: real estate, $5,000; stocks, $13,333.05; bonds, $1,000; crockery, tables, etc., $200. Receipts in 1893, $2,346.57: bounty, $600; stocks, $952.01; bonds, $60; new members, $69; other sources, $665.56. Expenditures in 1893, $3,244.79: premiums paid, $2,014.50; current running expenses, $1,188.01; interest, $42.28. The society offered in premiums $3,408.50, awarded $2,090.75* and paid $2,014.50,* which went to 30 cities and towns. Three hundred and sixty persons received premiums. Under head of farms $123 was awarded and $143 paid; under farm and pet stock $659 was awarded and $744 paid; under field and experimental crops $65 was awarded and $80 paid; under farm and garden products $433.25 was awarded and $489.50 paid; under dairy products $9 was awarded and $18 paid; under domestic manufactures $148.50 was awarded and $168.25 paid; under agricultural implements $57.50 was awarded and $50 paid; under objects strictly agricultural, not specified, $61 was awarded; under objects other than agricultural, not specified, $53 was awarded and $105 paid. The society reports 1,511 members, — 1,502 males and 9 females. Six farmers' institutes were held: at West Newbury, January 13, on "Poultry and how to make it profitable" and "Cooking;" at Rockport, January 27, on "Advantages of special and general farming" and "A brief history of organized agricultural work in the United States;" at Bradford, February 10, on "How to make small farms pay" and "Farm experiences in California;" at Beverly, February 24, on "Road building in Essex County, New Jersey," and "Fruits in general and pears in particular;" at Topsfield, March 17, on "Underdraining" and "Cranberry culture;" at Ipswich, March 31, on "Poultry" and "Milch cows."

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* Amounts paid for 1892; awarded for 1893.

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## FRANKLIN COUNTY AGRICULTURAL SOCIETY.

Incorporated 1850, Acts of 1850, Chapter 104.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,768; now has $7,020 invested as a capital stock in real estate and bank stock. Total assets, $7,312.74: real estate, $6,000; stocks, $1,020; bank funds, $212.74; crockery, tables, etc., $80. Total liabilities consist of premiums and gratuities unpaid to the amount of $31.75. Receipts in 1893, $2,609.41: bounty, $600; stocks, $51.68; bank funds, $13.70; new members, $80; donations, $20; other sources, $1,844.03. Expenditures in 1893, $3,004.76: premiums and gratuities paid, $1,071.25; current running expenses, $786.54; other expenses, $1,146.97. The society offered in premiums $1,350.50, awarded in premiums and gratuities $1,103, and paid $1,071.25, which went to 16 towns. Two hundred and thirty-nine persons received premiums and 8 gratuities. Under head of farm and pet stock $765 was awarded and $747.50 paid; under farm and garden products $173.75 was awarded and $166.25 paid; under dairy products $23 was awarded and paid; under domestic manufactures $129.75 was awarded and $120 paid; under trotting $505 was awarded and paid; under objects other than agricultural, not specified, $16 was awarded and paid. Diplomas were awarded for agricultural implements. The society reports about 1,800 members,—1,500 males and 300 females. Four farmers' institutes were held: at Greenfield, February 4, on "The gypsy moth and other insect pests;" at Bernardston, February 15, on "Farm economy;" at Northampton, February 16, on

"Tobacco culture;" at Conway, March 4, on "An outlook on the situation, or the farmer as a citizen" and "The best feeds for dairy stock."

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## HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1844, Acts of 1844, chapter 56.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $4,860; now has $1,144 invested as a capital stock in real estate, bank funds, crockery, tables, etc. Total assets, $1,144: real estate, $700; bank funds, $394; crockery, tables, etc., $50. Receipts in 1893, $1,431.68: bounty, $600; new members, $2.50; donations, $25.75; other sources, $803.43. Expenditures in 1893, $1,806.72: premiums and gratuities paid, $545.64; current running expenses, $946.08; other expenses, $315. The society offered in premiums $1,793.50, awarded $621.50 in premiums and gratuities, and paid $545.64, which went to 12 cities and towns. Eighty persons received premiums and 4 gratuities. Under head of farms $10 was awarded and paid; under farm and pet stock $315 was awarded and $294 paid; under field and experimental crops $31.50 was awarded and $29 paid; under farm and garden products $128.50 was awarded and $90.86 paid; under dairy products $5 was awarded and paid; under domestic manufactures $65.50 was awarded and $63.78 paid; under agricultural implements $26 was awarded and $13 paid; under trotting $315 was awarded and paid; under objects other than agricultural, not specified, $40 was awarded and paid. The society reports 1,065 members, — 873 males and 192 females. Four farmers' institutes were held: at Northampton, February 16, on "Tobacco culture;" at Holyoke, February 24, on "Dairying;" at Wilbraham, March 16, on "Orcharding, or the cultivation of fruit;" at Springfield, April 20, on "The horse for to-morrow: where shall we find it?"

## HAMPSHIRE AGRICULTURAL SOCIETY.

Incorporated 1814, Acts of 1814, chapter 19.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,255.26: now has $4,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $4,122.56: real estate, $3,850; bank funds, $122.56; crockery, tables, etc., $150. Total liabilities, $1,117.75: outstanding bills, $292.75; mortgages or like liabilities, $825. Receipts in 1893, $1,877.30: bounty, $600; new members, $45; donations, $109.75; other sources, $1,122.55. Expenditures in 1893, $1,877.30: premiums and gratuities paid, $658.50; current running expenses, $473.86; interest, $47.38; other expenses, $697.56. The society offered in premiums $879, and awarded and paid in premiums and gratuities $658.50, which went to 16 cities and towns. Seventy-four persons received premiums and 3 gratuities. Under head of farm and pet stock $374 dollars was awarded and paid; under field and experimental crops $25 was awarded and paid; under farm and garden products $119 was awarded and paid; under dairy products $8 was awarded and paid; under domestic manufactures $30.25 was awarded and paid; under objects strictly agricultural, not specified, $77 was awarded and paid; under trotting $595.75 was awarded and paid, under objects other than agricultural, not specified, $25.25 was awarded and paid. The society reports 782 members, — 549 males and 233 females. Three farmers' institutes were held: at Sunderland, January 31, on "Money crops: potatoes, onions and tobacco;" at Northampton, February 16, on "Tobacco culture;" at Amherst, March 24, on "Village improvements," and a cooking school.

## HAMPSHIRE, FRANKLIN AND HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 125.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be

$8,141.29; now has $3,153.63 in personal property. Total assets, $3,153.63: real estate lease, $2,800; crockery, tables, etc., $300; bills due, $50; cash, $3.63. Total liabilities, $125: premiums due, $25; outstanding bills, $100. Receipts in 1893, $3,118.13: bounty, $600; new members, $63; other sources, $2,455.13. Expenditures in 1893, $3,182.76: premiums and gratuities paid, $741.75; current running expenses, $980.91; interest, $58; other expenses, $1,402.10. The society offered $1,127.35 in premiums, awarded $877.03 in premiums and gratuities, and paid $741.75, which went to 15 cities and towns. Two hundred and fifty persons received premiums and gratuities. Under head of farms $25 was awarded and paid; under farm and pet stock $470 was awarded; under field and experimental crops $18 was awarded; under farm and garden products $158 was awarded; under dairy products $15 was awarded; under domestic manufactures $19.50 was awarded; under agricultural implements $20 was awarded and paid; under trotting $670.50 was awarded and paid; under objects other than agricultural, not specified, $164 was awarded. The society reports 819 members, — 665 males and 154 females. Three farmers' institutes were held; at Northampton, January 4, on "A trip to the farms and fruit plantations of California and the far West;" at Williamsburg, January 20, on "Dairying;" at Northampton, February 16, on "Tobacco culture."

## HIGHLAND AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 145.

Originally raised by contribution, $3,262; now has $3,100 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $3,141.76: real estate, $3,000; crockery, tables, etc., $100; cash, $41.76. Receipts in 1893, $1,638.97: bounty, $582.45; new members, $28; donations, $4; other sources, $1,024.52. Expenditures in 1893, $1,597.21: premiums and gratuities paid, $670.60; current running expenses, $923.61; interest, $3. The society offered in premiums $806.05, and awarded and paid in premiums and gratuities $670.60, which went to 25 cities and towns. One hundred and seventy persons received premiums and 2 gratuities. Under head of farm and pet stock $397.50 was awarded and paid; under field and experimental crops $37 was awarded and paid; under farm and garden products $36.45 was awarded and paid; under dairy products $8.50 was awarded and paid; under domestic manufactures $76.65 was awarded and paid; under agricultural implements $1 was awarded and paid; under trotting $68 was awarded and paid; under objects other than agricultural, not specified, $45.50 was awarded and paid. The society reports 445 members,— 315 males and 130 females. Three farmers' institutes were held: at Hinsdale, January 24, on "Dairying;" at Middlefield, September 6, on "Roads and schools;" at Middlefield, October 30, on "The testing of milk and cream."

### HILLSIDE AGRICULTURAL SOCIETY.

Incorporated 1883, Acts of 1883, chapter 112.

Originally raised by contribution $3,113.32; now has $5,160.96 invested as a capital stock in real estate, bank funds, cash, crockery, tables, etc. Total assets, $5,160.96: real estate, $4,124.53; bank funds, $293.36; crockery, tables, etc., $375.35; cash, $367.72. Total liabilities consist of premiums unpaid to the amount of $9.15. Receipts in 1893, $1,489.07: bounty, $600; new members, $131; donations, $35.78; all other sources, $722.29. Expenditures in 1893, $1,168.21: premiums and gratuities paid, $714.85; current running expenses, $393.83; other expenses, $59.53. The society offered in premiums $732, awarded $724, and paid $714.85, which went to 16 towns. Three hundred and forty-seven persons received premiums. Under head of farms $8 was awarded and paid; under farm and pet stock $424.75 was awarded and $414.85 paid; under field and experimental crops $47 was awarded and paid; under farm and garden products $83.85 was awarded and paid: under dairy products $14.75 was awarded and paid; under domestic manufactures $76.70 was awarded and paid; under agricultural implements $10 was awarded and $9 paid; under objects strictly agricultural, not specified, $20 was awarded and $16.70 paid; under trotting $25 was awarded and paid; under objects other than agricultural, not specified, $15 was awarded and $18.25 paid. The society reports 610 members, — 585 males and 25 females. Five farmers' institutes were held: at Williamsburg, January 25, on "Dairying;" at Ashfield, February 26, on "Gypsy Moth and other insects injurious to vegetation;" at Chesterfield, February 17, on "Apples" and "Small Fruits;" at Cummington, August 25, on "Education;" at Cummington, September 26, on "Fruits."

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## HINGHAM AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 99.

Originally raised by contribution $17,406.15; now has $22,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $22,488.44: real estate, $20,000; crockery, tables, etc., $2,000; cash, $488.44. Total liabilities consist of mortgages or like liabilities to the amount of $1,000. Receipts in 1893, $3,277.09: bounty, $600; new members, $312; donations, $187.45; other sources, $2,177.64. Expenditures in 1893, $3,073.15; premiums and gratuities paid, $779.53; current running expenses, $1,756.51; interest and notes, $293.39; other expenses, $243.72. The society offered in premiums $1,960.80, and awarded and paid $668.20 in premiums and gratuities, which went to 15 cities and towns. One hundred and ninety-five received premiums and 250 gratuities. Under head of farm and pet stock $370.90 was awarded and paid; under farm and garden products $129.70 was awarded and paid; under dairy products $10 was awarded and paid; under domestic manufactures $83.55 was awarded and paid; under objects other than agricultural, not specified, $59.45 was awarded and paid. The society reports 738 members, — 516 males and 22 females. Six farmers' institutes were held at Hingham: January 2, on "Agricultural experiments;" February 4, on "Cranberries: can they be profitably raised in Hingham?" March 4, on "Floriculture, horticulture and farming in the Azores;" March 27, on "Maple-sugar making in Vermont;" April 17, on "The horse for to-morrow in connection with agricultural societies;" November 20, on "What is the best education for a young man to enable him to make a success in farming?"

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## HOOSAC VALLEY AGRICULTURAL SOCIETY.

Incorporated 1860, Acts of 1860, chapter 56.

Originally raised by contribution $2,006; now has $13,450 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $13,524.88: real estate, $13,000; crockery, tables, etc., $450; bills due, $74.88. Total liabilities consist of notes to the amount of $900. Receipts in 1893, $5,920.33: bounty, $600; new members, $55; other sources, $5,265.33. Expenditures in 1893, $5,920.33: premiums paid, $3,040.30; current running expenses, $2,473.63; interest, $56.40; improvements, $350. The society offered in premiums $3,995 and awarded and paid $3,040.30, which went to 13 cities and towns. Sixty dollars went to four towns outside the State. Two hundred and four persons received premiums. Under head of farm and pet stock $523 was awarded and paid; under farm and garden products $207.50 was awarded and paid; under dairy products $23 was awarded and paid; under domestic manufactures $200.50 was awarded and paid; under agricultural implements $20 was awarded and paid; under trotting $1,600.75 was awarded and paid; under objects other than agricultural, not specified, $70.25 was awarded and paid. The society reports 952 members, — 937 males and 15 females. Three farmers' institutes were held: at North Adams, January 4, on "Horses;" at Williamstown, December 20, on "Manner and methods of farming;" at North Adams, December 30, on "State roads."

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## HOUSATONIC AGRICULTURAL SOCIETY.

Incorporated 1848, Acts of 1848, chapter 101.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be

$6,335.33; now has $12,773.98 invested as a capital stock in real estate, stocks, bank funds, crockery, tables, etc. Total assets, $13,309.25: real estate, $11,000; stocks, $1,000; bank funds, $773.98; crockery, tables, etc., $200; cash, $335.27. Total liabilities, outstanding bills, $250 (estimated). Receipts in 1893, $7,143.98: bounty, $600; stocks, $87.50; bank funds, $25.44; new members, $198.67; other sources, $6,232.37. Expenditures in 1893, $6,741.27: premiums paid, $2,863; current running expenses, $2,560.36; interest, $27.91; other expenses, $1,290. The society offered in premiums $2,321, awarded $2,873.50, and paid $2,863, which went to 21 cities and towns. Four hundred and twenty-five persons received premiums. Under head of farm and pet stock $1,003.50 was awarded and $1,002.50 paid; under field and experimental crops $224 was awarded and $221 paid; under farm and garden products $273 was awarded and $269 paid; under dairy products $42 was awarded and paid; under domestic manufactures $360 was awarded and $357 paid; under trotting $800 was awarded and $780 paid; under objects other than agricultural, not specified, $171 was awarded and paid. The society reports 1,595 members, — 1,544 males and 51 females. Three farmers' institutes were held at Great Barrington: January 4, on "Village and wayside improvement;" January 17, on "The horse for to-morrow: where shall we find it?" February 28, on "The anatomy, functions and diseases of the horse's foot."

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## MARSHFIELD AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 116.

Originally raised by contribution $3,755.43; now has $22,980.08 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $22,980.08: real estate, $21,472.78; crockery, tables, etc., $1,507.30. Total liabilities, $6,340: premiums unpaid, $30; outstanding bills, $210; mortgages or like liabilities, $6,100. Receipts in 1893, $3,278.14: bounty, $600; new members, $20; donations, $45.50; other sources, $2,612.64. Expenditures in 1893,

$4,651.97: premiums and gratuities paid, $1,385.72; current running expenses, $2,868.25; interest, $398. The society offered in premiums $1,640.50, awarded in premiums and gratuities $1,415, and paid $1,385.72, which went to 30 cities and towns. Three dollars and sixty cents went to one city outside the State. Sixty persons received premiums and 250 gratuities. Under head of farm and pet stock $295 was awarded and paid; under field and experimental crops $7.75 was awarded and paid; under farm and garden products $143.65 was awarded and $75.95 paid; under dairy products $18.75 was awarded and paid; under domestic manufactures $78.06 was awarded and paid; under trotting $787 was awarded and paid; under objects other than agricultural, not specified, $23.70 was awarded and paid. The society reports 862 members, — 556 males and 306 females. Four farmers' institutes were held at Marshfield: January 12, on "The future of agricultural societies;" January 25, on "Practical farming and poultry raising;" March 3, on "The embellishment of grounds by means of trees and shrubs" and "The anatomy, functions and diseases of the horse's foot;" December 19, on "Raising and selling of fruits and vegetables."

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## MARTHA'S VINEYARD AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 33.

Originally raised by contribution $4,552.17; now has $4,105.70 invested as a capital stock in real estate, notes, bank funds, crockery, tables, etc. Total assets, $4,134.07: real estate, $2,750; notes, $550; bank funds, $605.70; crockery, tables, etc., $200; bills due, $27; cash, $1.37. Total liabilities consist of premiums due and unpaid to the amount of $18. Receipts in 1893, $1,237.92: bounty, $600; notes, $41; bank funds, $30.70; new members, $30; other sources, $536.22. Expenditures in 1893, $1,543.80: premiums and gratuities paid, $622.37; current running expenses, $227.72; other expenses, $693.71. The society offered $814.85 in premiums and awarded and paid $622.37 in premiums and gratuities, which went to 5 towns. Sixty-nine persons received premiums and 120 gratuities. Under farms $8 was awarded and paid; under farm and pet stock $213.95 was awarded and paid; under field and experimental crops $55.50 was awarded and paid; under farm and garden products $130.90 was awarded and paid; under dairy products $19.85 was awarded and paid; under domestic manufactures $141.67 was awarded and paid; under objects other than agricultural, not specified, $52.50 was awarded and paid. The society reports 216 members,—90 males and 126 females. Four farmers' institutes were held: at Edgartown, April 22, on "Sheep raising;" at West Tisbury, May 26, on "Cranberry culture;" at West Tisbury, September 21, on "Can farming be made profitable in Martha's Vineyard?" at West Tisbury, November 22, on "Horses: what shall the society do to secure the people of the island the best kind and quality of horses?"

## MASSACHUSETTS HORTICULTURAL SOCIETY.

Incorporated 1829, Acts of 1829, chapter 22.

The first investment was from surplus Jan. 16, 1835, and amounted to $525. The society now has $247,000 invested as a capital stock in real estate, fixtures, bonds and library. Total assets, $321,097.72: real estate, $250,000; bonds, $13,480; bank funds, $10,627.49; crockery, tables, library, stereotype plates, etc., $39,567.92; bills due, $360.01; cash, $7,062.30. Total liabilities $1,039: premiums due and unpaid, $39; mortgage or like liability, $1,000. Receipts in 1893, $30,321.09: bounty, $600; bonds, $705; bank funds, $214.10; new members, $720; donations, $67.50; other sources, $28,614.49. Expenditures in 1893, $24,287.14: premiums and gratuities paid, $6,870.58; current running expenses, $17,416.56. The society offered in premiums $7,850, awarded $6,909.58 and paid $6,870.58, which went to 74 cities and towns. Seventy-five dollars went to 7 cities and towns outside the State. One hundred and ninety-six* persons received premiums and 149* gratuities. Under head of farms $440 was awarded and $290† paid; under farm and garden products $6,853.20 was awarded and $6,870 58† paid. The society reports 789 members,—

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* Except window gardeners. † For 1892.

736 males and 53 females. Eleven farmers' institutes were held at Horticultural Hall, Boston: January 14, on "Village improvement;" January 21, on "Landscape gardening;" January 28, on "Historical sketch of English horticulture;" February 4, on "The progress of horticultural societies;" February 11, on "Fungi;" February 18, on "Wild flowers and ferns;" February 25, on "Carnations and their culture;" March 4, on "Poisonous plants;" March 11, on "Aquatic plants;" March 18, on "Tuberous-rooted begonias;" March 25, on "Rational methods in the treatment of forests in New England."

## MASSACHUSETTS SOCIETY FOR PROMOTING AGRICULTURE.

Incorporated 1792, Acts of 1792, chapter 33.

This society made no returns to the secretary of the Board of Agriculture for the year 1893.

## MIDDLESEX AGRICULTURAL SOCIETY.

Incorporated as The Western Society of Middlesex Husbandmen in 1803, Special Laws, Vol. III.; name changed to The Society of Middlesex Husbandmen and Manufacturers, 1819, Acts of 1819, chapter 73; name changed to Middlesex Agricultural Society, 1852, Acts of 1852, chapter 30.

This society made no returns of finances or membership and held no fair in 1893. The society held three farmers' institutes: at Hudson, February 23, on "Does farming pay?" and "Vegetable culture;" at Boxborough, March 2, on "Crops most profitable to grow" and "Vegetable culture;" at Bedford, March 22, on "Stock feeding" and "Vegetable culture."

## MIDDLESEX NORTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 315.

Originally raised by contribution $3,000; now has $35,000 invested as a capital stock in real estate. Total assets, $35,475: real estate, $35,000; crockery, tables, etc., $450; bills due and unpaid, $25. Total liabilities, $3,562: premiums unpaid, $45; outstanding bills, $17; mortgages or like liabilities, $3,500. Receipts in 1893, $4,897.03: bounty, $600; new members, $26; other sources, $4,271.03. Expenditures in 1893, $3,204.21: premiums and gratuities paid, $843.25; current running expenses, $1,405.20; interest, $258.75; other expenses, $697.11. The society offered in premiums $1,497.75, awarded in premiums and gratuities $816.96 and paid $843.25, which went to 13 cities and towns. Three hundred and twenty-nine persons received premiums and 118 gratuities. Under head of farm and pet stock $420.25 was awarded; under field and experimental crops $15 was awarded; under farm and garden products $251 was awarded; under dairy products $7 was awarded; under domestic manufactures $119 was awarded. The society reports 931 male members. Three farmers' institutes were held: at Lowell, January 18, on "Feeding farm animals;" at Pepperell, March 29, on "What we know of bacteria, or the cause of contagious diseases" and "Milk and milk testing;" at Westford, May 11, on "Market gardening in the field" and "Gardening under glass."

## MIDDLESEX SOUTH AGRICULTURAL SOCIETY.

Incorporated 1854, Acts of 1854, chapter 84.

Originally raised by contribution $3,000; now has $15,000 invested as a capital stock in real estate. Total assets, $15,200: real estate, $15,000; crockery, tables, etc., $200. Total liabilities, $7,383.29: outstanding bills, $83.29; mortgages or like liabilities, $7,300. Receipts in 1893, $2,935.73: bounty, $600; new members, $92; donations, $16.55; other sources, $2,227.18. Expenditures in 1893, $2,935.73: premiums and gratuities paid, $1,050.83; current running expenses, $1,489.45; interest, $395.45. The society offered $1,437.68 in premiums, awarded and paid $1,050.83 in premiums and gratuities, which went to 9 cities and towns. One hundred and twenty-eight persons received premiums and 67 gratuities. Under head of farms $24 was awarded and paid; under farm and pet stock $278.25 was awarded and paid; under field and experimental crops $105 was awarded and paid; under farm and garden products $111.95 was awarded and paid; under domestic manufactures $63.35 was awarded and paid; under trotting $475 was awarded and paid; under objects other than agricultural, not specified, $13.50 was awarded and paid. The society reports 551 members, — 354 males and 197 females. Three farmers' institutes were held: at Framingham, January 17, on "Market gardening;" at Holliston, March 2, on "Winter feeding of stock;" at Ashland, March 14, on "Growing small fruits for family use."

## NANTUCKET AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 25.

Originally raised by contribution $3,500; now has $3,200 invested as a capital stock in real estate. Total assets, $3,232.20: real estate, $3,200; cash, $32.20. Receipts in 1893, $1,259.26: bounty, $600; new members, $19; other sources, $640.26. Expenditures in 1893, $1,227.06: premiums and gratuities paid, $606.75; current running expenses, $620.31. The society offered $1,186 in premiums, and awarded and paid $606.75 in premiums and gratuities, which went to 1 town. Two hundred and four persons received premiums and 123 gratuities. Under head of farms $23 was awarded and paid; under farm and pet stock $303.25 was awarded and paid; under field and experimental crops $7.75 was awarded and paid; under farm and garden products $77.50 was awarded and paid; under dairy products $9 was awarded and paid; under domestic manufactures $90 was awarded and paid; under trotting $48 was awarded and paid; under objects other than agricultural, not specified, $48.25 was awarded and paid. The society reports 514 members, — 211 males and 303 females. Three farmers' institutes were held at Nantucket: November 16, on "Milch cows and dairy farming;" November 25, on "General farm topics;" December 2, on "Dairies of cattle."

## OXFORD AGRICULTURAL SOCIETY.

Incorporated 1888, Acts of 1888, chapter 93.

Originally raised by contribution $4,400; now has $8,310.14 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $8,310.14: real estate, $7,500; crockery, tables, etc., $200; cash, $610.14. Total liabilities, mortgages or like liabilities, $1,000. Receipts in 1893, $3,279.03: bounty, $600; new members, $55; donations, $34; other sources, $2,590.03. Expenditures in 1893, $2,668.89: premiums paid, $1,194.69; current running expenses, $400; interest, $62.50; other expenses, $1,011.70. The society offered in premiums $1,700, awarded $1,213.50, and paid $1,194.69, which went to 15 cities and towns. Forty-five dollars went to two towns outside the State. One hundred and twenty-six persons received premiums. Under head of farms $40 was awarded and paid; under farm and pet stock $495.50 was awarded and $482.69 paid; under field and experimental crops $56.75 was awarded and $55.88 paid; under farm and garden products $21.50 was awarded and paid; under dairy products $6 was awarded and paid; under domestic manufactures $28.25 was awarded and $25.49 paid; under agricultural implements $3 was awarded and paid; under trotting $540 was awarded and paid; under objects other than agricultural, not specified, $22.50 was awarded and $20.13 paid. The society reports 625 members, — 336 males and 289 females. Three farmers' institutes were held: at Oxford, January 21, on "Cultivation of fruit;" at Millbury, December 21, on "Taxation" and "Poultry;" at Dudley, December 27, on "Butter making and milk testing" and "Equal taxation."

## PLYMOUTH COUNTY AGRICULTURAL SOCIETY.

Incorporated as the Agricultural Society in the County of Plymouth, 1819, Acts of 1819, chapter 2; name changed to Plymouth County Agricultural Society in 1870, Acts of 1870, chapter 251.

The society in its first report to the Board in 1853 reported its permanent fund (par value) to be $9,550; now has $35,217.98 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $35,217.98: real estate, $35,000; crockery, tables, etc., $200; cash, $17.98. Total liabilities, notes, $3,200. Receipts in 1893, $10,780: bounty, $600; new members, $46; other sources, $10.134. Expenditures in 1893, $10,762.02: premiums and gratuities paid $3,201.85; current running expenses, $2,637.96; interest, $204.85; other expenses, $4,717.36. The society offered in premiums $3,988.50, awarded and paid $3,201.85 in premiums and gratuities, which went to 36 cities and towns. One hundred dollars went to one town outside the state. Three hundred and thirty-six persons received premiums and 18 gratuities. Under head of farms $39 was awarded and paid; under farm and pet stock $692.25 was awarded and paid; under field and experimental crops $42 was awarded and paid; under farm and garden products $170.85 was awarded and paid; under dairy products $31 was awarded and paid; under domestic manufactures $204.50 was awarded and paid; under agricultural implements $5 was awarded and paid; under trotting $1,985 was awarded and paid; under objects other than agricultural, not specified, $48.25 was awarded and paid. The society reports 1,612 members — 950 males and 662 females. Three farmers' institutes were held; at Middleborough, January 11, on "Cranberry culture;" at West Bridgewater, March 10, on "Market farming;" at Bridgewater, December 19, on "Dairying."

## SPENCER FARMERS AND MECHANICS ASSOCIATION.

Incorporated 1888, Acts of 1888, chapter 87.

Originally raised by contribution $4,034 08; now has $7,800 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $8,146.49; real estate, $7,000; crockery, tables, etc., $800; cash on hand, $346.49. Total liabilities consist of mortgages or like liabilities to the amount of $1,500. Receipts in 1893, $3,588.14: bounty, $600; new members, $28; donations, $400; other sources, $2,560.14. Expenditures in 1893, $3,241.65: premiums and gratuities paid, $1,843.72; current running expenses, $1,330.43; interest, $67.50. The association offered in premiums $2,525, awarded in premiums and gratuities $1,874.25, and paid $1,843.72, which went to 23 cities and towns. Twenty-five dollars went to one city outside the State. One hundred and thirty-one persons received premiums and 28 gratuities. Under head of farms $60 was awarded and paid; under farm and pet stock $834.25 was awarded and $816.50 paid; under field and experimental crops $40 was awarded and $37.25 paid; under farm and garden products $85.50 was awarded and $75.47 paid; under dairy products $10 was awarded and paid; under domestic manufactures $49.50 was awarded and paid; under trotting $775 was awarded and paid; under objects other than agricultural, not specified, $20 was awarded and paid. The society reports 963 members, — 537 males and 426 females. Three farmers' institutes were held: at Spencer, January 10, on "The advantages of New England farming as compared with the South and West" and "Horses;" at Oakham, February 14, on "How to make small farms pay" and "Co-operative farming;" at Spencer, March 23, on "Bringing up the farm" and "What education does the farmer require?"

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## UNION AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 110.

Originally raised by contribution $4,447.23; now has $9,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $9,303.17: real estate, $8,000; crockery, tables, etc., $1,000; cash, $303.17. Total liabilities, $2,390.75: premiums and gratuities unpaid, $140.75; mortgages or like liabilities, $2,250. Receipts in 1893, $3,069.75: bounty, $600; new members, $128; other sources, $2,341.75. Expenditures in 1893, $2,766.58: premiums and gratuities paid, $1,117.95; current running expenses, $824.94; interest, $89.86; other expenses, $733.83. The society offered $1,817.55 in premiums, awarded in premiums and gratuities $1,258.70 and paid $1,117.95, which went to 22 cities and towns. Six dollars and fifty-one cents went to four towns outside the State. Two hundred and one persons received premiums and 109 gratuities. Under head of farm and pet stock $553.90 was awarded and $518.45 paid; under field and experimental crops $36.50 was awarded and paid; under farm and garden products $45.50 was awarded and $44.50 paid; under dairy products $14 was awarded and paid; under domestic manufactures $114 was awarded and $95.20 paid; under agricultural implements $10 was awarded and $9.50 paid; under objects strictly agricultural, not specified, $87 was awarded and paid; under trotting $385.50 was awarded and $380 paid; under objects other than agricultural, not specified, $14.30 was awarded and $12.90 paid. The society reports 1,216 members, — 559 males and 657 females. Three farmers' institutes were held at Blandford: January 19, on "Our birds and insect life;" April 21, on "Poultry: its care and keeping for profit;" June 29, on "Forage crops: principally grasses."

## WEYMOUTH AGRICULTURAL AND INDUSTRIAL SOCIETY.

Incorporated 1891, Acts of 1891, chapter 77.

Amount originally raised by contribution had increased in 1891 to $10,270, invested as a capital stock in real estate, crockery, tables, etc. Total assets, $10,277.23: real estate, $10,000; crockery, tables, etc., $270; cash, $7.23. Total liabilities, $2,775: mortgage, $1,500; note, $1,275. Receipts in 1893, $4,428.17: bounty, $600; new members, $10; donations, $40.30; other sources, $3,777.87. Expenditures in 1893, $4,533,94: premiums and gratuities paid, $654.96; current running expenses, $2,311.24; interest, $155.96; other expenses, $1,411.78. The society offered in premiums $779.10, awarded $680.38 and paid $654.96, which went to 17 cities and towns. Three hundred and forty-five persons received premiums and gratuities. Under head of farm and pet stock $387 was awarded and $375.10 paid; under farm and garden products $116.10 was awarded and $111.25 paid; under dairy products $4.50 was awarded and paid; under domestic manufactures $137.78 was awarded and $129.11 paid; under trotting $671 was awarded and paid; under objects other than agricultural, not specified, $35 was awarded and paid. The society reports 449 members, — 437 males and 12 females. Three farmers' institutes were held: at South Weymouth, February 10, on

"Market gardening;" at East Weymouth, March 10, on "Poultry;" at South Weymouth, March 31, on "Milk and its production."

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## WORCESTER AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 168.

The society in its first report to the Board in 1853 reported its permanent fund (par value) to be $7,730; now has $140,000 invested as a capital stock in real estate. Total assets, $146,043.63: real estate, $140,000; bank funds, $5,843.63; crockery, tables, etc., $200. Total liabilities consist of mortgages or like liabilities to the amount of $50,000. Receipts in 1893, $28,308.10: bounty, $600; bank funds, $142.10; new members, $635; donations, $50; other sources, $26,881. Expenditures in 1893, $27,004.38: premiums and gratuities paid, $9,944.50; current running expenses, $7,728.21; interest, $2,250; other expenses, $7,-081.67. The society offered in premiums $11,215.50, and awarded and paid $9,944.50, which went to 83 cities and towns. One thousand nine hundred and twenty-three dollars went to 24 cities and towns outside the State. Two hundred and eighty-five persons received premiums and 8 gratuities. Under head of farms $129 was awarded and paid; under farm and pet stock $3,469.50 was awarded and paid; under field and experimental crops $130 was awarded and paid; under farm and garden products $920 was awarded and paid; under dairy products $105 was awarded and paid; under domestic manufactures $130.50 was awarded and paid; under trotting $5,106 was awarded and paid; under objects other than agricultural, not specified, $84.50 was awarded and paid. Diplomas were awarded for certain domestic manufactures and other objects strictly agricultural, not specified. The society reports 2,058 members,—1,934 males and 124 females. Three farmers' institutes were held: at Worcester, January 13, on "Market gardening" and "Deciduous and conifer trees;" at Holden, February 15, on "Feeding of stock" and "Fertilizers;" at Grafton, March 21, on "How to make small farms pay" and "Feeding of stock for dairy purposes."

## WORCESTER EAST AGRICULTURAL SOCIETY.

Incorporated 1890, Acts of 1890, chapter 41.

Originally raised by contribution $1,015; now has $4,246.65 invested as a capital stock in real estate, bank funds, crockery, tables, etc. Total assets, $4,246.65: real estate, $2,712; bank funds, $1,292.65; crockery, tables, etc., $242. Receipts in 1893, $6,126.02: bounty, $600; bank funds, $27.30; new members, $235; donations, $337; other sources, $4,926.72. Expenditures in 1893, $6,512.73: premiums and gratuities paid, $1,087; current running expenses, $4,158.61; new buildings, $1,267.12. The society offered in premiums $1,475, awarded in premiums and gratuities $1,145.75, and paid $1,087, which went to 16 cities and towns. One hundred and ninety-five persons received premiums and 22 gratuities. Under head of farms $26 was awarded and paid; under farm and pet stock $599.50 was awarded and paid; under farm and garden products $301.50 was awarded and $295 paid; under dairy products $10 was awarded and paid; under domestic manufactures $72 was awarded and paid; under agricultural implements $20 was awarded and paid; under objects strictly agricultural, not specified, $50 was awarded and paid; under trotting $405 was awarded and paid; under objects other than agricultural, not specified, $84 was awarded and paid. The society reports 639 members, — 438 males and 201 females. Three farmers' institutes were held: at Lancaster, January 19, on "Fruit culture;" at West Boylston, February 28, on "The qualities of milk, with tests by the Babcock tester;" at Lancaster, April 20, on "The inequalities of taxation."

## WORCESTER NORTH AGRICULTURAL SOCIETY.

Incorporated as the Fitchburg Agricultural Society, 1852, Acts of 1852, chapter 79; name changed to Worcester North Agricultural Society, 1853, Acts of 1853, chapter 359.

Originally raised by contribution $2,128; now has $4,116.83 invested as a capital stock in real estate, fixtures and cash. Total assets, $4,116.83: real estate, $2,500; crockery, tables, etc., $300; cash, $1,316.83. Receipts in 1893, $2,920.89: bounty, $600; new members, $41; donations, $25; other sources, $2,254.89. Expenditures in 1893, $2,991.37: premiums paid, $909.80; current running expenses, $2,081.57. The society offered $1,280 in premiums, awarded $953.75 and paid $909.80, which went to 16 cities and towns. Under head of farms $44 was awarded and paid; under farm and pet stock $406 was awarded and $397 paid; under farm and garden products $232.25 was awarded and $219.25 paid; under dairy products $3.75 was awarded and paid; under domestic manufactures $21 was awarded and $20.25 paid; under agricultural implements $2 was awarded and paid; under objects strictly agricultural, not specified, $90 was awarded and paid; under trotting $165 was awarded and paid; under field sports $153.79 was awarded and paid; under objects other than agricultural, not specified, $78.55 was awarded and paid. The society reports 781 members, — 725 males and 56 females. Five farmers' institutes were held: at Ashburnham, January 5, on "How to make small farms pay;" at Fitchburg, January 18, on "Fruit culture;" at Leominster, January 26, on "Feeding for milk;" at Ashby, March 21, on "Dairy products;" at Westminster, March 24, on "Fertilizers and how to use them."

## WORCESTER NORTHWEST AGRICULTURAL AND MECHANICAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 117.

Originally raised by contribution $3,400; now has $12,098.06 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $12,098.06: real estate, $11,000; crockery, tables, etc., $400; cash, $698.06. Total liabilities, $2,040.53: premiums unpaid, $40.53; mortgages or like liabilities, $2,000. Receipts in 1893, $6,440.58: bounty, $600; new members, $62.50; all other sources, $5,778.08. Expenditures in 1893, $5,984.77: premiums paid, $1,870.62; current running expenses, $1,825.35; interest, $5.70; other expenses, $2,283.10. The society offered $2,621 in premiums, awarded $1,911.15 and paid $1,870.62, which went to 28 cities and towns. One hundred and thirty-three dollars went to 3 cities and towns outside the State. One hundred and eighty-seven persons received premiums. Under head of farms $31 was awarded and paid; under farm and pet stock $789.50 was awarded and $768.49 paid; under farm and garden products $169.75 was awarded and $167.03 paid; under dairy products $17 was awarded and paid; under domestic manufactures $53.65 was awarded and $43.60 paid; under trotting $831.75 was awarded and paid; under objects other than agricultural, not specified, $18.50 was awarded and $11.75 paid. The society reports 869 members, — 586 males and 283 females. Three farmers' institutes were held: at Athol, January 17, on "The cultivation of small fruits;" at Petersham, February 7, on "A trip to the farms and fruit plantations of California and the far West" and "How to make small farms pay;" at Gardner, February 16, on "Market gardening in the field and under glass."

## WORCESTER SOUTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 278.

Originally raised by contribution $3,127.40; now has $8,500 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $8,610.15: real estate, $8,000; crockery, tables, etc., $500; cash, $110.15. Total liabilities, $961: premiums unpaid, $61; mortgages or like liabilities, $900. Receipts in 1893, $3,532.97: bounty, $600; new members, $67; other sources, $2,875.97. Expenditures in 1893, $3,229.26: premiums and gratuities paid, $1,569.50; current running expenses, $1,437.91; interest, $50; other expenses, $171.85. The society offered $2,100 in premiums, awarded $1,630.50 in premiums and gratuities and paid $1,569.50, which went to 27 cities and towns. One hundred and thirty-one persons received premiums and 56 gratuities. Under head of farms $54 was awarded and paid; under farm and pet stock $691.25 was awarded and $643 paid; under farm and garden products $106.50 was awarded and $100.25 paid; under dairy products $33 was awarded and paid; under domestic manufactures $90.75 was awarded and $88.25 paid; under agricultural implements $2 was awarded and paid; under objects strictly agricultural, not specified, $45 was awarded and paid; under trotting $530 was awarded and paid; under objects other than agricultural, not specified, $18 was awarded and paid. The society reports 1,802 members, — 924 males and 878 females. Three farmers' institutes were held: at Warren, January 30, on "Dairying" and "Milk testing;" at Southbridge, March 8, on "Cultivation of small fruits" and "Some of the causes of the depression of farming in New England;" at Sturbridge, December 20, on "The cultivation of small fruits."

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## WORCESTER COUNTY WEST AGRICULTURAL SOCIETY.

Incorporated 1851, Acts of 1851, chapter 278.

Originally raised by contribution $3,175; now has $13,600 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $13,651.66: real estate, $12,600; crockery, tables, etc., $1,000; bills due, $35.50; cash, $16.16. Total liabilities, two notes, $1,400. Receipts in 1893, $3,030.05: bounty, $600; new members, $45; donations, $35.73; other sources, $2,349.32. Expenditures in 1893, $3,098.23: premiums and gratuities paid, $1,397.67; current running expenses, $1,638.06; interest, $62.50. The society offered $1,644.50 in premiums, awarded $1,433.40 in premiums and gratuities, and paid $1,397.67, which went to 27 cities and towns. One hundred and fifty-five persons received premiums and 39 gratuities. Under head of farms $75 was awarded and paid; under farm and pet stock $613 was awarded and $601 paid; under field and experimental crops $34 was awarded and paid; under farm and garden products $49.65 was awarded and $46.45 paid; under dairy products $12 was awarded and $11 paid; under domestic manufactures $47.05 was awarded and $46.95 paid; under agricultural implements $9.50 was awarded and $3 paid; under trotting $570 was awarded and paid: under objects other than agricultural, not specified, $47.75 was awarded and $46 paid. The society reports 551 members, — 498 males and 53 females. Three farmers' institutes were held at Barre: January 27, on "Dairying" and "Milk testing;" February 10, on "The ideal life of farmers;" February 21, on "The normal school: why the farmer should favor it."

*Summary.*

| | 1891. | 1892. | 1893. |
|---|---|---|---|
| Number of societies, . . . . . . | *38 | †38 | †38 |
| Amount held invested or well secured as a capital stock, . . . . . . | $742,558 26 | $757,407 44 | $777,880 36 |
| Assets of societies, . . . . . . | 776,831 26 | 838,379 45 | 865,247 67 |
| Liabilities of societies, . . . . . | 116,190 39 | 118,046 24 | 131,085 52 |
| Receipts, . . . . . . . . . | 208,292 30 | 222,737 17 | 199,461 90 |
| Expenditures, . . . . . . . | 191,157 74 | 202,739 21 | 193,930 58 |
| Bounty received from the State, . . | 20,802 20 | 21,352 49 | 20,982 45 |
| Current running expenses, . . . | 86,501 66 | 79,854 89 | 69,891 88 |
| Amount of premiums offered, . . . | 79,645 61 | 78,787 46 | 81,022 73 |
| Amount of premiums and gratuities awarded, . . . . . . . | 60,869 56 | 59,386 04 | 64,401 66 |
| Amount of premiums and gratuities paid, | 59,168 71 | 59,265 84 | 62,994 84 |
| Amount awarded under head of farms, . | 1,440 00 | 1,428 00 | 1,425 00 |
| Amount awarded under head of farm and pet stock, . . . . . . . | 22,145 79 | 21,776 95 | 20,905 40 |
| Amount awarded under head of field and experimental crops, . . . . . | 1,029 63 | 1,460 00 | 1,138 50 |
| Amount awarded under head of farm and garden products, . . . . . . | 13,025 02 | 12,764 91 | 12,824 50 |
| Amount awarded under head of dairy products, . . . . . . . | 686 75 | 616 80 | 572 35 |
| Amount awarded under head of domestic manufactures, . . . . . . | 3,655 49 | 3,833 06 | 3,820 33 |
| Amount awarded under head of miscellaneous, . . . . . . . . | 4,308 64 | 3,539 71 | 3,451 70 |
| Amount awarded under head of trotting, | 21,416 39 | 20,548 25 | 22,115 00 |
| Number of persons receiving premiums, . | 7,480 | 7,265 | 8,103 00 |
| Number of persons receiving gratuities, . | 2,225 | 1,746 | 1,597 00 |
| Total male membership of the societies, . | 24,143 | 24,365 | 23,918 00 |
| Total female membership of the societies, | 7,465 | 7,372 | 6,834 00 |
| Total membership of the societies, . . | 31,608 | 31,747 | 30,752 00 |
| Number of farmers' institutes held, . . | 141 | 132 | 135 |

* Two held no fair.

† Three held no fair.

## ANNUAL MEETING

OF THE

# BOARD OF AGRICULTURE

## AT BOSTON.

February 6, 7 and 8, 1894.

# ANNUAL MEETING.

The Board met at the office of the secretary, in Boston, on Tuesday, Feb. 6, 1894, at 12 M., it being the Tuesday preceding the first Wednesday in February. In the absence of the Governor, Hon. JAMES S. GRINNELL was elected president *pro tem.*

Present: Messrs. Alger, Appleton, Bancroft, Bowker, Bucklin, Bursley, Clapp, Clemence, Cook, Cruickshanks, Cushman, Damon, Fowler, French, Grinnell, Goessmann, Harwood, Hartshorn, Hersey, Holbrook, Horton, Kilbourn, Kimball, Newhall, Pratt, Rawson, Reed, Richards, G. C. Rowley, J. H. Rowley, Sargent, Shaw, Taylor, Varnum, Ward, Warren, West and Wood.

The secretary presented a copy of the report of the gypsy moth committee, already transmitted to the Legislature, which was, after discussion by various members, accepted and adopted. This report will be found printed in this volume.

*Voted*, That the executive committee prepare an order of business for the afternoon session.

Adjourned to 2.30 P.M.

Board called to order by Mr. GRINNELL at 2.30 P.M.

The secretary read the records of the morning session.

Mr. Wood, chairman of the executive committee, presented a proposed order of business for the afternoon session, which was adopted by a vote of the Board.

The records of the meetings of the executive committee, acting for the Board, were read and approved, and their action adopted as the action of the Board. Also the records of the special meeting at Great Barrington were read and approved.

A committee of three, to examine and report upon the credentials of newly-elected members, was appointed by the Chair: Messrs. Bancroft, Kilbourn and Newhall.

Mr. Bowker, chairman of the committee appointed at the last annual meeting to codify the rules and regulations of the Board and all existing by-laws, to prepare such further by-laws as might seem necessary, and to recommend the appointment of certain standing committees for the performance of certain specified work, which committee reported at the special meeting at Great Barrington and which report was referred back to the committee, the committee enlarged, and instructions given to report to the annual meeting, presented the amended report of the committee.

The chairman of the committee read the proposed by-laws chapter by chapter, each chapter being considered, amended and accepted as read, and the whole was adopted by vote of the Board.

The roposed rules and regulations were then taken up and considered rule by rule, and were accepted and adopted as read. The proposed recommendations of the Board were read and adopted.

Mr. J. D. W. French offered the following resolutions, which were unanimously passed: —

*Resolved*, That the State Board of Agriculture approves House bill (H. R. No. 119), "A Bill to protect public forest reservations," and urges the immediate passage of said bill.

*Resolved*, That a copy of these resolutions be sent to the Senators and Representatives of this State in the United States Congress.

The secretary reported on matter of portrait of Hon. John E. Russell.

The secretary made report on the societies failing to comply with the laws of the State and the regulations of the

Board, which report was referred to the executive committee, with instructions to report recommendations of action.

Adjourned to 9.30 A.M. Wednesday.

## SECOND DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: Messrs. Alger, F. H. Appleton, J. S. Appleton, Jr., Bancroft, Bourne, Bowker, Bursley, Clapp, Clemence, Cook, Cruickshanks, Cushman, Damon, Fowler, Goessmann, Gove, Grinnell, Hartshorn, Harwood, Hersey, Horton, Kilbourn, Kimball, Lyman, Mills, Newhall, Palmer, Pratt, Raymond, Reed, Rowley, Sargent, Shaw, Tucker, Varnum, Ward, Warren, West and Wood.

The records of the first day were read by the secretary and approved.

The committee on credentials, by its chairman, Mr. Bancroft, reported that it had found by the financial reports of the several societies that thirty-five were entitled to representation on this Board. Of these societies twenty had members whose terms had not expired, seven had re-elected their former delegates and eight had elected new delegates to the Board, and that all had sent to the secretary proper certificates of their choice. The newly elected members are as follows: —

At large, appointed by the Governor: —
SPRAGUE S. STETSON of Lakeville.

Elected by the societies: —
Amesbury and Salisbury, F. W. SARGENT of Amesbury.
Attleborough, ISAAC ALGER of Attleborough.
Berkshire, SAMUEL M. RAYMOND of Hinsdale.
Blackstone Valley, HENRY A. COOK of Northbridge.
Eastern Hampden, W. M. TUCKER of Monson.
Hampden, F. E. CLARK of Wilbraham.
Hampshire, Franklin and Hampden, C. B. LYMAN of Southampton.

Hingham, EDMUND HERSEY of Hingham.
Hoosac Valley, WM. H. GOVE of North Adams.
Housatonic, FRANK A. PALMER of Stockbridge.
Marshfield, JOHN H. BOURNE of Marshfield.
Massachusetts Horticultural, E. W. WOOD of West Newton.
Nantucket, JOHN S. APPLETON, Jr., of Nantucket.
Weymouth, Q. L. REED of South Weymouth.
Worcester East, W. A. KILBOURN of South Lancaster.

Which report was accepted.

The following committees of three were appointed: —

On assignment of delegates: Messrs. HERSEY, HARWOOD and HORTON.

On place of holding public winter meeting: Messrs. CRUICKSHANKS, WARD and BURSLEY.

On change of time of holding fairs: Messrs. BANCROFT, CLEMENCE and KILBOURN.

On essays for the next annual meeting: Messrs. WOOD, F. H. APPLETON and KIMBALL.

The report of the Dairy Bureau (Senate No. 8) was presented and read by the secretary and was accepted and adopted by the Board. This report will be found printed in this volume.

The secretary made report of the work of the past year under the law for collecting and circulating information on abandoned and partially abandoned farms. The report was accepted and adopted, and it was

*Voted*, That it is the opinion of the Board that the work should be continued and extended as far as the appropriations will warrant.

The secretary read an abstract of the reports of delegates to fairs, which reports were accepted.

Mr. Wood, chairman of the executive committee, reported on the matter of colors used in awarding premiums, that correspondence had been had with Boards of Agriculture and State Agricultural Societies in many States, with the following results: Of 24 States and New Brunswick heard from, 22 use blue for "1st premium," red for "2d premium" and white for "3d premium;" one uses red for "1st premium," white for "2d premium" and blue for "3d premium;" and one has no fixed rule. As the rule of the Board is in line with the practice in the majority of the States, the committee recommended no change.

The report of the committee was accepted.

Mr. F. H. Appleton submitted a proposition that section 1 of chapter 114 of the Public Statutes be amended by adding, after the word "premiums" in the next to the last line, the words "or shall otherwise apply for the encouragement or improvement of agriculture or manufactures," so that the section will correspond and agree with section 7 of said chapter.

*Voted*, To refer the matter to the executive committee.

Mr. Bancroft, for the committee on changes of time for holding fairs, reported that no requests for changes had been received, which report was accepted.

Mr. Shaw stated that he understood the Bristol County society wished a change of date and asked that the rule regarding changes of date be suspended.

*Voted*, To suspend the rule.

*Voted*, That the date for holding the fair of the Bristol County society be changed to the fourth Tuesday after the first Monday in September.

The secretary read a communication from the secretary of the Massachusetts State Grange relative to the use of score-cards and scales of points as recommended by the State Board; also relative to exhibitions of oleomargarine and butterine at the fairs of the several societies.

*Voted*, on motion of Mr. F. H. Appleton, That the matter be referred to the committee on Dairy Bureau and agricultural products, with instructions to report at the next annual meeting.

The secretary read a communication from Mr. Ethan Brooks of West Springfield in regard to the propriety of societies offering premiums for small nurseries of apple trees grown on our Massachusetts farms, and especially grown by the young people, girls as well as boys, with the intent that such trees shall when ready be planted in orchards on or near the farms where the trees originate.

The secretary read a communication from Mr. F. T. Fuller of Weston, asking for the co-operation of the Board in the effort to secure the enactment of Senate Bill No. 23, being a bill "providing for the reclamation of the Sudbury Meadows and the protection of the public health in the valleys of the Concord and Sudbury rivers."

*Voted*, That the matter be referred to the executive committee.

The secretary read a communication from Dr. George M. Twitchell of Augusta, Me., in regard to societies being required to hold stock two days, and that they should fix an hour when entries should close and then stick to it; also, that in connection with the score-card, on a fly-leaf, there should be an illustration of the ideal animal of each breed and of different varieties of fruits and vegetables.

No action was taken by the Board.

Mr. Elbridge Cushman read an essay on "The restoration of exhausted farms by practical methods," which was accepted and will be found printed in this volume.

At 12.30 the Board adjourned to 2 P.M.

The Board was called to order at 2 P.M., Mr. GRINNELL in the chair.

Mr. C. F. Fowler read an essay on "Tobacco culture," which was accepted and will be found printed in this volume.

Mr. F. H. Appleton presented the following resolutions: —

*Whereas*, The present law directs that the director at the State Agricultural Experiment Station shall not publish the valuation of the plant food contained in fertilizers analyzed by the station;

*Resolved*, That we, a meeting of farmers of Essex County, request the State Board of Agriculture to consider the expediency of taking action towards securing such change in the laws as shall authorize the director of said station to publish the valuation, as was previously done.

*Resolved*, That we request our delegate to present this matter at the meeting of the State Board of Agriculture in February next.

After discussion the resolutions were laid on the table.

The report of the examining committee of the Agricultural College was read by the chairman, Mr. Charles A. Mills, and was, by vote of the Board, accepted and adopted as the report of the Board of Agriculture to the Legislature.

The executive committee, by its chairman, Mr. Wood, reported concerning the delinquent societies and reasons given therefor, and recommended that all except the Hampshire, Franklin and Hampden be excused, and the secretary be instructed to write them that they are excused, but must comply with all laws and regulations in the future; and that the Hampshire, Franklin and Hampden be strongly censured and notified that measures will be taken to withhold the bounty next year unless the society complies strictly with all laws and regulations of the Board.

*Voted*, That the report of the committee be accepted and the recommendations adopted.

*Voted*, on motion of Mr. Cushman, That the election of officers and appointment of committees be assigned to Thursday at 10 A.M.

Mr. Edmund Hersey read an essay on "Cranberry culture," which was accepted and will be found printed in this volume.

Mr. William Bancroft read an essay on "The pleasures of farming," which was accepted and will be found printed in this volume.

*Voted*, That the laws relating to the Board of Agriculture and Agricultural Societies be compiled and codified by the secretary and printed with the by-laws in the "Agriculture of Massachusetts" and in pamphlet form.

*Voted*, That the secretary be directed to communicate with the several societies to ascertain how many score-cards they want at the contract price for State printing, in order that a sufficient supply may be obtained for the use of the several societies without expense to the Board of Agriculture.

*Voted*, That the executive committee be directed to inquire into the cost and expediency of including cuts of types of the various fruits in connection with the scale of points for fruits, and, if found advisable, cause them to be printed.

At 4.30 P.M. the Board adjourned to 9.30 A.M. Thursday.

## THIRD DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: His Excellency F. T. Greenhalge and Messrs. Alger, F. H. Appleton, J. S. Appleton, Jr., Bancroft, Bourne, Bowker, Bursley, Clark, Clemence, Cook, Cushman, Cruickshanks, Damon, Goessmann, Gove, Grinnell, Hartshorn, Harwood, Hersey, Horton, Kilbourn, Kimball, Lyman, Newhall, Palmer, Pratt, Raymond, Reed, Rowley, Sargent, Shaw, Tucker, Varnum, Ward, Warren, West and Wood.

The secretary read the records of the second day, which were approved.

Mr. Hersey, for the committee on assignment of delegates, reported the following: —

| | |
|---|---|
| Amesbury and Salisbury (Agricultural and Horticultural), . . . . . . . | J. BURSLEY. |
| Attleborough (Agricultural Association), . | F. W. SARGENT. |
| Barnstable County, . . . . . . . | J. E. KIMBALL. |
| Berkshire, . . . . . . . . | W. M. TUCKER. |
| Blackstone Valley, . . . . . . . | C. B. LYMAN. |

| | |
|---|---|
| Bristol County, | J. S. Appleton, Jr. |
| Deerfield Valley, | E. A. Harwood. |
| Eastern Hampden, | F. A. Palmer. |
| Essex, | G. C. Rowley. |
| Franklin County, | W. H. Bowker. |
| Hampden, | D. A. Horton. |
| Hampshire, | Q. L. Reed. |
| Hampshire, Franklin and Hampden, | W. A. Kilbourn. |
| Highland, | N. W. Shaw. |
| Hillside, | J. H. Bourne. |
| Hingham (Agricultural and Horticultural), | I. Alger. |
| Hoosac Valley, | I. Damon. |
| Housatonic, | A. Pratt. |
| Marshfield (Agricultural and Horticultural), | E. Warren. |
| Martha's Vineyard, | H. A. Cook. |
| Massachusetts Horticultural, | Geo. Cruickshanks. |
| Middlesex North, | C. L. Hartshorn. |
| Middlesex South, | F. E. Clark. |
| Nantucket, | E. Hersey. |
| Oxford, | A. C. Varnum. |
| Plymouth County, | E. W. Wood. |
| Spencer (Farmers' and Mechanics' Association), | H. A. Barton, Jr. |
| Union (Agricultural and Horticultural), | L. W. West. |
| Weymouth (Agricultural and Horticultural), | J. C. Newhall. |
| Worcester, | F. H. Appleton. |
| Worcester East, | Wm. Bancroft. |
| Worcester North, | G. L. Clemence. |
| Worcester North-west, | S. M. Raymond. |
| Worcester South, | W. H. Gove. |
| Worcester County West | C. E. Ward. |

Report accepted and adopted.

The committee on essays for the next annual meeting reported, by its chairman, as follows: —

### Essays.

| | |
|---|---|
| Breeding and care of dairy stock, | E. A. Harwood. |
| Farming as an occupation, | Chas. E. Ward. |
| Field crops, | Prof. Wm. P. Brooks. |
| Subject to be assigned, | A. C. Varnum. |

Report accepted and adopted.

The committee on place for holding the public winter meeting reported, by its chairman, Mr. Cruickshanks, that the meeting should be held at Newburyport. The report was accepted, and the Board voted to hold the next public winter meeting at Newburyport, provided the arrangements with the hotels can be made satisfactory.

It being 10 o'clock, the special assignments were called up.

*Voted*, That the Chair nominate a committee of three to nominate the specialists. Messrs. Bowker, F. H. Appleton and West were appointed.

The election of officers being in order, ballots were taken separately on each officer to be elected, and the elections resulted as follows: —

President, His Excellency the Governor, *ex officio*.
First vice-president, JAMES S. GRINNELL of Greenfield.

The Governor, coming in, took the chair.

Second vice-president, FRANCIS H. APPLETON of Peabody.
Secretary, WILLIAM R. SESSIONS of Hampden.
Member Board of Control of State Agricultural Experiment Station, C. L. HARTSHORN of Worcester.

*Voted*, on motion of Mr. F. H. Appleton, That the Chair appoint a local committee of five to act with the secretary in arranging for the public winter meeting. Messrs. Appleton, Sargent, Varnum, Wood and Damon were appointed.

The chairman announced the following standing committees (the secretary is by rule of the Board a member *ex officio* of each of the standing committees): —

Executive committee: E. W. WOOD (chairman), E. HERSEY, WM. BANCROFT, C. L. HARTSHORN, A. C. VARNUM, WM. H. BOWKER and F. H. APPLETON.

Committee on agricultural societies: E. HERSEY (chairman), Q. L. REED, N. W. SHAW, F. E. CLARK and WM. H. GOVE.

Committee on domestic animals and sanitation: WM. BANCROFT (chairman), W. A. KILBOURN, I. DAMON, W. M. TUCKER and G. C. ROWLEY.

Committee on gypsy moth, insects and birds: E. W. WOOD (chairman), F. H. APPLETON, WM. H. BOWKER, A. PRATT and F. W. SARGENT.

Committee on Dairy Bureau and agricultural products: C. L. Hartshorn (chairman), D. A. Horton, G. L. Clemence, J. C. Newhall and F. A. Palmer.

Committee on Agricultural College and education: A. C. Varnum (chairman), Geo. Cruickshanks, E. A. Harwood, J. E. Kimball and J. Bursley.

Committee on experiments and station work: Wm. H. Bowker (chairman), C. L. Hartshorn, L. W. West, C. E. Ward and H. A. Cook.

Committee on forestry, roads and roadside improvements: F. H. Appleton (chairman), E. Warren, J. H. Bourne, I. Alger and S. M. Raymond.

The Board approved of the nominations and the several committees were declared elected.

Mr. Bowker, for the committee to nominate experts, reported nominations. Ballots being taken, the following elections resulted: —

Chemist, Dr. C. A. Goessmann of Amherst.
Entomologist, Prof. C. H. Fernald of Amherst.
Botanist and pomologist, Prof. S. T. Maynard of Amherst.
Veterinarian, Prof. Jas. B. Paige of Amherst.
Engineer, Wm. Wheeler of Concord.
Ornithologist, E. H. Forbush of Malden.

*Voted*, That the secretary be authorized to procure such tables and desks for the use of the Board in the new rooms of the Board as in his judgment may be deemed necessary.

*Voted*, on motion of Mr. Wood, That the executive committee of the Board petition the present Legislature to enact such legislation as will make the secretary *ex officio* a member of the Board of Agriculture.

A vote of thanks was unanimously tendered the chairman for the able and impartial manner in which he had discharged his duty as presiding officer.

*Voted*, on motion of Mr. Newhall, That the executive committee be directed and authorized to petition Congress in aid of a "petition for a Federal act to enable the States to enforce State laws regulating the sale of substitutes for dairy products."

The records of the third day were read and approved.

Adjourned.

WILLIAM R. SESSIONS,
*Secretary.*

# AGRICULTURAL EXHIBITIONS, 1894.

AMESBURY AND SALISBURY at *Amesbury*, September 25, 26 and 27.
ATTLEBOROUGH at *North Attleborough*, October 2, 3 and 4.
BARNSTABLE COUNTY at *Barnstable*, September 11, 12 and 13.
BERKSHIRE at *Pittsfield*, September 11, 12 and 13.
BLACKSTONE VALLEY at *Uxbridge*, September 25 and 26.
BRISTOL COUNTY at *Taunton*, September 25, 26 and 27.
DEERFIELD VALLEY at *Charlemont*, September 13 and 14.
EASTERN HAMPDEN at *Palmer*, September 18 and 19.
ESSEX at *Haverhill*, September 18, 19 and 20.
FRANKLIN COUNTY at *Greenfield*, September 20 and 21.
HAMPDEN at *Westfield*, September 20 and 21.
HAMPSHIRE at *Amherst*, September 25 and 26.
HAMPSHIRE, FRANKLIN AND HAMPDEN at *Northampton*, September 18 and 19.
HIGHLAND at *Middlefield*, September 5 and 6.
HILLSIDE at *Cummington*, September 25 and 26.
HINGHAM at *Hingham*, September 25 and 26.
HOOSAC VALLEY at *North Adams*, September 18, 19 and 20.
HOUSATONIC at *Great Barrington*, September 26, 27 and 28.
MARSHFIELD at *Marshfield*, September 12, 13 and 14.
MARTHA'S VINEYARD at *West Tisbury*, September 18 and 19.
MASSACHUSETTS HORTICULTURAL at *Boston*, October 2, 3 and 4.
MIDDLESEX NORTH at *Lowell*, September 13, 14 and 15.
MIDDLESEX SOUTH at *Framingham*, September 11 and 12.
NANTUCKET at *Nantucket*, September 5 and 6.
OXFORD at *Oxford*, September 18 and 19.
PLYMOUTH COUNTY at *Bridgewater*, September 19, 20 and 21.
SPENCER at *Spencer*, September 20 and 21.
UNION at *Blandford*, September 12, 13 and 14.
WEYMOUTH at *South Weymouth*, September 27, 28 and 29.
WORCESTER at *Worcester*, September 4, 5, 6 and 7.
WORCESTER EAST at *Lancaster*, September 13 and 14.
WORCESTER NORTH at *Fitchburg*, September 18 and 19.
WORCESTER NORTH-WEST at *Athol*, October 2 and 3.
WORCESTER SOUTH at *Sturbridge*, September 13 and 14.
WORCESTER COUNTY WEST at *Barre*, September 27 and 28.

# REPORT TO THE LEGISLATURE OF THE STATE BOARD OF AGRICULTURE, ACTING AS OVERSEERS OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

[P. S., Chap. 20, Sect. 5, adopted by the Board Feb. 7, 1894.]

The members of the examining committee of the Agricultural College have visited the college separately from time to time during the year, and they were together in attendance at the examination of the senior class for the Grinnell prizes in June.

The past year has been one of great prosperity to the college. The Legislature appropriated money necessary to carry out last year's requests and recommendations. A larger number of students than ever before are availing themselves of the advantages here afforded for culture of both mental and bodily faculties.

Were your committee to write an extended report it would be on the lines indicated in our last report — that the college is doing a useful work in providing for wide culture upon subjects especially connected with the farmer's calling; that the college farm and its equipment are becoming more and more an ideal object lesson to any who will inspect them, while the bulletins and reports explaining clearly the result of experiments are messengers of useful information to any of our citizens who will read and profit by them.

The annual report of the trustees of the college, already printed, gives in detail the condition of the various departments, while its urgent needs, especially as to increasing the number of dormitories and of providing more recitation rooms, are clearly set forth. To this report we give our cordial endorsement.

Respectfully submitted,

CHAS. A. MILLS.
A. C. VARNUM.
E. A. HARWOOD.
GEORGE CRUICKSHANKS.
GEO. L. CLEMENCE.

# TOBACCO CULTURE.

BY C. F. FOWLER OF WESTFIELD.

In entering upon the discussion of the cultivation of tobacco let it not be supposed for one moment that I have thought that I could instruct an old grower of tobacco, or even direct a new one, so that he might grow a satisfactory crop every time. These things come not by the telling, but are learned only from that old and incorrigible schoolmaster, experience.

Every one that enters into this business will find that "toilsome days and weary nights are appointed unto him," and will often wish he never had seen a tobacco plant; and although the backaches of the past may be dispensed with by the machine setters of the present, yet continual watchfulness and care will ever remain with the grower as a necessity for the production of a good crop.

A mistake in the selection of his ground or a neglect in its cultivation and care can often only be known at the season's end, when the crop is ready for market, and can never be remedied; for a tobacco plant must never stop growing after once started until it is cut from the ground, and just so surely as it does it will show in color or texture, no matter what the cause is, whether too much moisture or not enough moisture, a lack of fertility or lack of care; in fact, anything that checks or stops growth is sure to manifest itself in the end; and not only in the field but in the sheds also must this ever watchfulness be continued.

To give just the light, air and moisture that will bring out the best and most even colors, to prevent pole sweat and white veins, and give to the leaf the best possible finish and elasticity — to accomplish these results as far as possible the moist air of night or the drier air in the day must be admitted to the sheds or excluded as the case may demand. Yet, with all the care and watchfulness we may bestow, often disappointment is the lot of the grower, and his visions of profit are overborne by the present consciousness of loss. But growers who have been struggling unaided in the past are now beginning to receive that aid from science so long desired, which we hope will soon enable us to produce with more certainty the kind and quality of leaf we seek.

While the growing and using of tobacco has been carried on in this country since its first discovery by Columbus in 1492, yet its systematic culture was not begun until 1612, and from that time until the present it has been one of the industrial products of this country in increasing quantities, until at the present time it is one of our great staple productions.

I shall not attempt in this brief paper to give a complete history of this large industry, or treat of its cultivation except so far as may concern its culture in New England.

In the earlier days of tobacco culture in New England nothing appears to have been known of its proper preparation for market, and, indeed, it is related that the process of sweating out the rank flavor and the starting of the industry in this section were by a Suffield (Conn.) merchant, who, having taken a lot of tobacco to cancel a bad debt, packed it in boxes so as to economize in room, where it remained a year or two, when, being in New York, he traded it for groceries as the boys used to swap jack-knives — "sight unseen" — at what he called a good price, about five or six cents a pound, and thankful he was well rid of bad assets. What was his surprise a time after to receive a request from his customer in New York for some more of that "same kind" of tobacco, and inquiring the name of it. Of course, the shrewd Connecticut Yankee gave it a name, which was Connecticut Seed, and placed himself in a situation to continue the trade so accidentally commenced. This was previous to or about 1825, and from this time more attention was paid to its cultivation, and as a knowledge of its preparation for market and growing increased, its merits as a cigar wrapper became better known, the demand became greater, and the area of its cultivation gradually extended up the river and into the adjacent valleys, so that in 1850 there was grown in New England 1,414,920 pounds, of which Massachusetts raised only 138,246 pounds and Connecticut 1,276,624.

Stimulated by better prices, the growth increased so that the product in New England in 1860 was 9,264,862 pounds, of which Massachusetts grew 3,233,198; in 1870, 15,869,-999 pounds, of which Massachusetts grew 7,312,385; in 1880, 19,717,401 pounds, of which Massachusetts grew 5,369,439; in 1890, 11,826,883 pounds, of which Massachusetts grew 2,794,848.

## Varieties.

There are about one hundred and twenty-five varieties of tobacco grown in the United States. Until about 1875 nearly all tobacco grown in New England was called Connecticut Seed as a general name, but often designated as Broad Leaf, Long Leaf, Willson's, and Williams' or Barber's, and many others, all of them noted for fineness of texture and color and especially adapted to wrap a good cigar.

The first experiment of which I can learn in growing Havana Seed for wrappers in New England was in 1856, when Hon. Thomas Kneil of Westfield procured some Havana seed, and Mr. Daniel Bush of the same town grew the tobacco for the firm of T. & J. Kneil, and continued to grow it for them as long as they were in business, receiving from them by agreement as much per acre as he obtained by growing Connecticut Seed Leaf. This seed was very carefully guarded by the grower and for about ten years only two growers had the improved seed. This I believe to be the commencement of the growth of this variety, and from this seed was distributed by the writer into Connecticut and up the valley.

Since about 1875 new seed has often been introduced from Cuba, which after a growth of a few years has been found to produce a leaf of such fine texture and flavor as to supersede every other variety, except in a very limited section in Connecticut. This Havana Seed, as it is called, has a smaller and thinner leaf, with small veins and of very even color. But the soil, fertilizer, cultivation and curing, as well as atmospheric conditions, have very much if not everything to do with, and make up this fine and silky leaf so much sought after. The leaf must also burn well with white ash, which must not flake or drop from the cigar in scales. The demand for different shades and colors varies with the fashion, which is about as changeable as is the color and style of dress. Just now the greatest demand is for light colors. How to obtain just the shade and quality of leaf desired is what has called out more effort and upon which has been expended more time and money than upon the production of any other crop grown.

### EXPERIMENTS.

Until within a short time this great crop has been entirely ignored by the experiment stations, and all experiments performed have been by private enterprise and of necessity rather crude and often unsatisfactory.

In the winter of 1891–2 there was organized in Windsor the Connecticut Tobacco Experiment Company, for the purpose of carrying on the business of an experiment in the culture and cure of tobacco, the same to be conducted and carried on in connection with and under the supervision of the Connecticut Agricultural Experiment Station. A stock subscription book was opened, and from the proceeds of the sale of stock land was purchased and a building built, officers elected and to J. A. Du Bon was committed the practical management of the experiment itself. The experiments are to continue through a series of five years.

The following are some of the questions which, as far as possible, were to receive immediate attention: —

(*a*) What is the effect on quantity and quality of leaf of larger applications of cotton-seed meal than are commonly used as a fertilizer?

(*b*) What is the comparative effect on quantity and quality of leaf of applications of castor pomace containing the same amounts of nitrogen as the cotton-seed meal used in experiments under *a*?

(*c*) If heavy application in form of castor pomace proves injurious to the leaf, can the injury be lessened or prevented if half of this nitrogen is applied by castor pomace and the other half by nitrate of soda?

(*d*) What are the comparative effects on quantity and quality of leaf with applications of equal quantities of potash in the following forms: cotton hull ashes, high-grade sulphate of potash, the same with lime, double sulphate of potash, the same with lime, pure carbonate of potash, and pure nitrate of potash?

(*e*) Is it possible to absolutely prevent pole-burn and to cure the crop perfectly on the stalk by the use, in very damp, "muggy" weather, of artificial heat simply as a means of ventilating and partly drying the air of the barns?

These questions of the effect of different fertilizers, climatic conditions and soil and their relations to each other are now receiving attention from the Massachusetts Tobacco Growers' Association, organized in the winter of 1892–3 in Northampton. The preparation of the fertilizers is under the direction of Professor Goessmann of the Experiment Station, and the composition is unknown by the grower or those who are to judge of the relative quality of the different plats.

It is proposed to have three or more pieces in different towns each piece to be divided into ten plats, and each plat to be fertilized with a different formula, these experiments to be continued for a term of years and upon the same ground.

The past season was very unfavorable on account of the extreme dry weather and only two pieces were raised. The results from these experiments are, of course, not ready to be reported. Each plat will be judged by experts before the sweat and again after, which will require much patient labor and time.

Upon the settlement of such questions as these organizations are working for depends largely the future prosperity of this industry so far as the growing of fine tobacco in New England is concerned. Of its sale in the market I will speak later on. The area upon which good wrapper leaf, such as the trade demands, can be grown is limited, and is practically confined to the Connecticut and Housatonic valleys, and even within these limits the production has been very far from uniform in color and quality, owing, without doubt, to the fact that in many instances a farmer has tried to grow tobacco because his neighbors did, not taking into consideration, perhaps, the fact that the soil upon his farm was very different from his neighbors'. As a rule, dark and heavy soils produce naturally a darker and heavier leaf than a lighter soil, and not only does soil, but fertilizers and the form in which they are applied, affect both color and quality, and the man who attempts to grow tobacco will soon learn that he is dealing with the most sensitive plant grown.

### SEED BED.

The first requisite for growing good tobacco is a good seed bed, with a sunny exposure. The best land for such a bed is a moist, sandy loam, which should be ploughed and made very rich the summer previous to using, by either manure, at the rate of fifty cords per acre, or good commercial fertilizer. No weeds should be allowed to mature upon the bed. In November the bed should be ploughed and harrowed thoroughly. In the spring the land should be worked lightly (but not when wet), and some quick-acting fertilizer applied, at least 500 pounds per acre. Sulphate of ammonia has proved a good substitute for Peruvian guano. This should be thoroughly raked in. Do not let your land dry out before sowing your seed, but roll your ground lightly, then sow your seed and roll again, and if dry, water immediately if you sow sprouted seed. I sprout my seed in apple-tree dirt, obtained from hollow apple trees, or by placing in cloth between two turfs and keeping moist in a warm place. One tablespoonful of seed to a square rod of land is about right.

The beds should be sown as early as the ground is in condition, from the 1st to the 10th of April. To get early plants the bed should be covered with glass or cloth, resting upon boards about a foot high; a good size for sash is 3 by 8 feet. If glass is used, care must be exercised to raise the sash on sunny days.

Many simply cover their beds with white-birch brush, erecting a tight fence as a wind-break. Plants raised in this manner are usually more hardy and stocky than when grown under cloth or glass, and will be from one to two weeks later.

### SELECTION OF LAND.

In selecting a field for growing tobacco I would select a light or warm sandy loam that had grown potatoes as a previous crop, or rather, would prefer a field where a crop of clover had been turned under the year previous. The subsoil should be porous to allow of quick drainage; yet the experience of the past extremely dry season would show the desirability of a soil that would stand a drought, if such can be found.

Our best pine-plain lands have been producing some of the finest tobacco grown for the past few years, especially when grown largely upon mixed fertilizers, and it is an open question whether these light soils may not prove to be the very best for tobacco, leaving the heavier soils for grass, to which they are more especially adapted.

### PREPARATION OF THE FIELD.

The land should be ploughed in the fall, and if possible horse manure at the rate of ten or twelve cords per acre ploughed in. The use of a little quick-acting tobacco fertilizer as a starter ought to give you a good growth. I prefer 6 or 8 cords of horse manure, and 1,500 pounds of cotton-seed meal, and 500 pounds cotton-hull ash, or 300 pounds high-grade potash. Many use too much potash. In the spring, if not manured in the fall, plough as early as soil is in condition and again just before setting. If set by hand, sow fertilizer in rows, three feet apart, and ridge, setting plants from fifteen to twenty inches apart.

### SETTING PLANTS.

Never set a small plant. Before plants are large enough to set, plough your land and sow fertilizer and harrow thoroughly, making the field as smooth as possible. I prefer to have the fertilizer sown at least one week before setting, to prevent burning the plants. Too much care cannot be given in lifting the plants after wetting the bed. If the ground is not too hard, they may be pulled with one hand and kept bunched in the other. When the hand is full, place in a shallow box, roots down. When the box is full, sprinkle and place in a cool, shady place or cellar where they may remain until wanted. Great care should be exercised in having the plants of the same size for machine setting. With a good team three men can set one-half acre or more per hour and water it. In dry weather plants live much better set by a machine than by hand, as the water is placed at the roots of the plants; but it requires practice on the part of the droppers to set evenly and well.

## Cultivation and Care.

As soon as the plants have commenced to grow, the ground should be stirred up by horse and hand hoe, loosening and breaking the ground immediately around the plants, allowing no weeds to become strongly rooted. At the second hoeing the soil should be brought up around the plant as much as possible, as the leaves will soon be so large as to prevent doing it later, and the plant needs this support to prevent being blown over by the winds. Most of the future cultivating can be done by the cultivator, raising the rows quite high to hold the plants up and prevent flooding by heavy rains.

## Topping and Suckering.

As soon as the plant has begun to show the white of the bud it should be topped. It is usually necessary to go over the field several times, as it will not all be ready at the same time. It should stand about four weeks after topping, depending somewhat upon the season, time of topping, etc.

Care should be exercised to keep the suckers from becoming too large. Usually twice suckering will be sufficient to keep it clean. The first time about six leaves down should be suckered, and the entire plant previous to cutting.

## Insect Pests.

One of the first insect pests to put in an appearance is the cut-worm. They commence working as soon as the plants are set, and often destroy many plants, necessitating a resetting. Probably the best way to get rid of them is by Paris green, about a heaping teaspoonful to six quarts of flour. No harm can come from its application, as the lower leaves never mature.

The green tobacco worm puts in an appearance about the last of July, and must be hunted and destroyed. Potatoes should never be planted by the side of tobacco, as the black flea breeds upon them and as the vines die they spread to and live upon the tobacco, causing what is called flea holes. The above-mentioned pests, with a good crop of grasshoppers, will keep you busy until the tobacco is ready to cut. This time is learned better by experience than from any written description; the leaves grow thicker and assume a mottled appearance.

### Harvesting and Stripping.

After cutting, the plant is allowed to wilt sufficiently to prevent breaking the leaves, when it is strung upon slats one and one-half by one-half inch and four feet long, drawn to the sheds upon a rack built for that purpose, and hung upon poles, the slats being placed from six to ten inches apart, according to size of tobacco and amount of air in the shed.

Great care should be exercised not to bruise the leaves, as every bruise will show in a changed color of the leaf when cured; also in not wilting the tobacco too much, as any pressure upon the leaf when too hot is sure to ruin it for a wrapper. The sheds are usually left open until the tobacco has begun to cure down in fine weather, care being taken to prevent injury by rain or wind beating in the doors.

As soon as the stems of the leaf are dried out, usually about the first of November, it is ready to strip from the stalk, and as soon as suitable weather will permit it is taken from the poles and piled, without removing from the slats, in seven-sided piles and covered to prevent drying. It can remain in this condition until stripped from the stalk without danger of heating.

As soon as convenient the plants are removed from the slats and the leaves carefully stripped from the stalk and bundled in double bundles with good strong paper. Stripping boxes are usually ten inches square inside, and thirty-eight or forty inches long. Lap enough so the bundles will not come apart.

These are carefully piled in hakes, two narrow boards being placed between the tiers of bundles, care being used to place them upon the sides. I have never been troubled with tobacco heating when packed in this way, always leaving it in this condition until sold or taken to the assorting table.

### ASSORTING.

The assorting of the crop requires great care and good judgment, and each grade should be uniform. I usually make seven grades, viz.: long wrapper, short wrapper, dark wrapper, long binder, short binder, top leaves, and fillers.

The long wrapper consists of the perfect long leaves of good color and quality; the short wrapper, the shorter perfect leaves, including the perfect light ground leaves; the dark wrapper, the dark colored and heavier large leaves; the binders, those not fit for wrappers in color and soundness, sized in length for appearance mostly; top leaves, the short top and heavy leaves, unfit for a binder, unavoidably heavier and darker and requiring a heavier sweat; the fillers are the bottom leaves and those not sound enough for binders. They rarely bring enough to the grower to pay for tying up, and are usually pressed into a case loose and sold to manufacturers to be made into snuff or fine cut, or for export.

After assorting it is tied in hands containing from twelve to fifteen leaves in a hand, using the strong tip leaves for tiers; it is then rebundled in paper and either sold to dealers or packed in cases, as the grower can find a customer or not. Very often the grower sells his crop in the bundle to the packer, who attends to assorting in his own shop. This is usually the best way to dispose of the crop, as but few growers can assort it to suit the packer, and as the trade now is, the grower is eventually obliged to dispose of his crop to the packer or dealer.

### PACKING.

In packing, good judgment must be exercised, and education is often bought very dearly by experience, many a crop being ruined by being cased too wet, or too dry, or too heavy.

The size of the case is governed by the length of the tobacco. From thirty by thirty-six to thirty by forty-two inches is the usual size. From 300 to 375 pounds are pressed into a case. It should be lapped enough so that the pressure shall be as heavy in the centre as at the ends. One inch space should be left between the ends of the hands and the case, so as to allow the steam to escape freely while in the sweat. Each case is numbered and marked with the weight and tare, and placed upon the side to sweat, which will require from six to nine months before being ready for the manufacturer to work.

## Marketing and Markets.

I have said that, as the markets now are, perhaps the wisest course for the grower is to sell to the packer in the bundle previous to assorting; but right here comes in a difficulty. The packer cannot assort the whole of the crop for lack of room for a sufficient amount of help, as a man can assort properly only from 100 to 150 pounds per day, and so the grower is often obliged to assort his crop. The marketing of tobacco is very different to-day from what it was a few years ago. Before the imposition of a government tax upon cigars and manufacturers there was a large number of small factories where growers could sell their crops without the aid of the dealer or packer. To-day but few small shops are in existence. They have been run out by the larger concerns, who buy only of dealers and in large quantities, and only the grade they then desire, whether wrappers or binders.

Another and by far the worst drawback to the New England leaf grower is the competition of Sumatra tobacco, grown on one of the East India islands by a Dutch syndicate, which employs coolie laborers at a few cents per day, and raises a leaf that has the merit of being very fine and of good color, three or four pounds of which will wrap a thousand cigars, whereas it will take from three to twelve pounds of our production to wrap the same number. The only redeeming thing about it is its looks. At present the duty is $2 per pound, which enables the growers of domestic leaf to compete successfully with their cheap labor and make living wages. The present movement to reduce the duty upon this leaf can have but one result, if successful, viz., to drive the New England grower out of the market, and ruin this great industry we have spent so much time and money to develop.

# CRANBERRY CULTURE.

BY EDMUND HERSEY OF HINGHAM.

To secure success in the business of growing cranberries, a bog should be selected that can be well drained at a moderate expense; it should have on its borders a good sand bank, free from clay or loam, and there should be a good supply of water that can be kept under full control at all seasons of the year. Without good drainage, whatever may be said to the contrary, the cranberry cannot be grown with success; in fact, it cannot be grown at all in water. Water is of value only when the plant is at rest or when used to kill insects and to prevent frosts; and even to use it for these purposes is destructive to the fruit and a great injury to the plant if kept on more than a few hours at each flooding. Because the cranberry grows naturally where the land is quite wet and usually flooded during the cold weather, the conclusion is too often drawn that water is essential to its growth; but a careful investigation will disclose the fact that where the cranberry grows naturally and produces good crops the water covers the surface of the bog only during the time the plants are in a dormant state; that before they begin to grow the water is from six to twelve inches below the tops of the plants, and that good drainage is secured by a net-work of partially decayed vegetation just below the growing cranberry plants. It is a fact that is now well known by observing cranberry growers that cranberries grow best on thoroughly drained land, with the water from twelve to eighteen inches below the surface during the summer months.

One of the principal advantages of covering a bog with sand is to furnish good drainage and more heat than can be obtained in a natural bog. While a cranberry plant set in sand, where the drainage is good, will frequently grow four feet the first season, it will not grow one foot if set in sand where the drainage is so poor that the water will stand in pools twelve hours after every shower. Water is important to success in cranberry growing, but it must be under the control of the grower at all seasons of the year. The bog may be covered with water from November until May to advantage, but it should not be let on all at once nor suddenly drawn off; the letting on and drawing off should cover several weeks of time, and a great depth of water is desirable only in the coldest weather, to keep the ice above the plants. The ditches should be well filled by the first of September and kept full until about the first of June, in order to protect the fruit in the autumn and the fruit-buds in the spring.

In whatever business man is to make much of a success, he must not only have all the conditions favorable, but must make himself acquainted with all the details, and, in fact, make himself master of the business. This applies to the cranberry business quite as well as to any other. If a bog cannot be easily drained, has no sand or fine gravel near it, and has not plenty of water, easily controlled, it would be well to hesitate about using it for growing cranberries; but if it has good drainage and good sand or gravel near, in eight years out of ten it might produce fair crops of fruit without water. While water is important, it is less so than either drainage or sand. With these three conditions favorable, no one who will give the business proper attention need hesitate to engage in it.

Having secured such a bog, the first work is to drain it. If it be a deep bog that has never been drained, allowance must be made for the settling of the surface after the water is drawn off. It is safe to allow eighteen inches if the outlet is to be lowered three feet below the surface of the bog; this will give a chance to draw the water at least twelve inches below the surface. In digging the ditches for draining, while the main water course may be in the centre of the bog, there should always be a ditch between the bog and the high land to catch all the water that flows over the surface of the surrounding high lands towards the bog. Having thoroughly drained the bog by lowering the water in the main ditch and preventing it from flowing in from the surrounding high lands, the work of constructing the bog should be commenced, beginning on the side where the outlet of the water is, and working back towards the point from which the water supply is to come. The first work should be the construction of a dam high enough to flood the bog at least three feet in depth, and the gateway should be so constructed that the water can be easily drawn entirely off, or raised to any depth desired. At the upper end, where the water enters the main ditch, a dam should be built for a reservoir large enough to contain water sufficient to flood the bog whenever desired.

In constructing the bog, if it be covered with grass, the sod should be entirely removed and carried off. But if it be covered with trees or bushes, the trees, before being cut, should be pulled over so as to more easily remove the roots by using the trunk of the tree for leverage. The roots of the larger trees will not grow below the top of the peat, which has for many years been below the water-level. This, as a rule, will be from six to nine inches below the surface on bogs that have never been drained for cultivation. The brush and roots should be piled up in large windrows to dry, and on the top of these should be shoveled the leaf mould, which is above the peat; thus leaving the surface perfectly level. When the roots and soil are dry enough, which will be in a few weeks, they should be burned up and the ashes saved for fertilizing other parts of the farm.

Ditches should be dug eighteen inches deep, eighteen inches wide at the bottom, and thirty inches at the top. These ditches should be seventy-five feet apart, running at right angles with the centre ditch and from it to the border ditch.

In constructing the bog, care should be taken to keep the surface at a water level. This can be easily done by keeping back water enough so as to have a few inches in the bottom of the ditches. When the ditches are all dug, and the brush, stumps and surface soil all disposed of by fire or removed to the high land, the bog is ready to sand. If it be a small one, wheelbarrows may be used to remove the sand, but if it be large, a hand car run on movable rails can be used with more economy. The sand should be free from clay or loam, and should be coarse enough to let the water through it freely. Very fine sand is not as good as fine gravel. Never use sand so fine that the water will stand on it in pools after every shower. To get good drainage, cover three or four inches in depth.

In regard to the selection of varieties of cranberries, always give preference to those with thick flesh, small cavities, dark color and good size. It is very difficult to find all these qualities combined in one variety, but if not to be found, come as near to it as possible. Never buy plants that grow in sections where destructive insects are at work on the vines, and, if possible, get them from a higher northern latitude than where they are to be set.

Before setting the plants, mark the ground off in rows ten inches apart, and set the vines ten inches apart in the rows. Plants having roots are much better than those without; but tops can be made to do very well if set while perfectly fresh, although they will not grow the first year more than half as much as those with roots. In setting vines, a stick with a notch in it should be used to push them into and through the sand. The plants do best set in April or May, but will live set at any time during the summer or autumn. When plants are set in summer, the water should be kept within six inches of the surface; and if set during the hottest portion of the season, it should be kept high enough to keep the sand on the surface from becoming so warm as to be unpleasant to those who are setting the plants.

During the first year care should be taken to keep the bog perfectly clean of all perennial weeds. The annual weeds need not be pulled out, as to do so will only disturb the cranberry plants.

When cold weather begins, the bog should be flooded deep enough to keep the ice above the plants. The following spring gradually draw off the water, having it all off by the first of May. During the summer keep the water at least twelve inches below the surface, and keep the lowland grasses out. When cold weather comes, flow as before; but in the spring draw the water gradually, and by the middle of May have it low enough to fill the ditches an inch below the surface of the bog, keeping it there until the first week in June, when it should be entirely drawn off and kept so until the first of September. Then if there be any fruit worth picking, the water should be let on high enough to fill all the ditches up near the surface of the bog, but not high enough to reach the fruit.

The third year, if the bog be a good one, but little work will be required except to weed out any seedling trees or shrubs that may come up. The cranberry vines will cover the surface enough to keep the grass out. If they do not it will be because the location is not a good one.

There are cranberry bogs in Plymouth County that have been in cranberries for sixty-five years and still produce good crops, although nothing has been done to them but to keep the ditches open and keep out the bushes.

While a very slight frost is destructive to a green cranberry, it is but little if any injury to a well-ripened one. For this reason, by keeping the ditches full of water during the period of slight frosts, while the fruit is ripening, as a rule, the crop will be saved; but should it be cold enough to freeze water, the crop can only be saved by flooding the whole bog. When this is done, the water should be drawn off early in the morning, before the sun warms it, or the fruit will be injured.

A frost in spring injures the crop by destroying the top buds of the upright shoots just before they burst open. As we seldom have only slight frosts at this stage in the growth of the plant, the water in the ditches will generally warm the atmosphere sufficient to prevent a frost on the plants.

In Massachusetts the fruit ought to be ripe enough to begin harvesting from the 10th to the 15th of September, and if possible should be all gathered in by the 1st of October. In picking the fruit, to secure good order and clean picking the bog should be lined off with strong twine drawn across from one cross ditch to another, about four feet apart, and the pickers required to keep within the lines assigned them. Six-quart pails are furnished the pickers, who are paid, usually, ten cents for each pailful picked, and when brought in are either paid the money or given a check representing the price paid. These are redeemed every night or once a week.

If the crop is to be kept until winter, a house, frost proof, should be built in which to store the fruit. Some growers pack it in bushel crates; others on shelves made in crib style, so the fruit will be about twelve inches in depth.

Just before sending to market the fruit should be picked over either by hand work or by the use of a machine made for the purpose.

In conclusion, never engage in cranberry culture unless you can locate where the conditions are favorable. Never purchase plants from localities where destructive insects have injured the vines or the fruit. Never set plants that are not prolific bearers and do not produce berries of thick flesh. Never half build a bog, but do it well or not at all; and, finally, let the business alone unless you care enough about it to make yourself familiar with all of its details, from the selection of the bog to the selling of the fruit.

# THE PLEASURES OF FARMING.

BY WM. BANCROFT OF CHESTERFIELD.

Mr. Chairman: — Perhaps I can best arrive at my subject by locating it. My home and farm are on the crest of a western Hampshire hill, 1,500 feet above the sea. In winter it is wind-scourged and blasted by gales from every quarter, yet the mercury never gets as low as in the valleys near me. In summer we are fanned by the western breezes, never knowing a sultry night, with the temperature always lower than it is beneath us. To have running water in our village is an impossibility. It runs away from us in every direction, and yet our homesteads are honeycombed with wells of excellent quality. From Williamsburg, the first town east of us, six miles distant, to Pittsfield, twenty-five miles west, the territory is the tail end of the Green Mountains, tapering off and losing themselves at the south in the northern edge of Connecticut, where it meets our State in Berkshire County. From my lawn I have a broken and most picturesque horizon distant from ten to fifty miles. From early morn till nightfall, summer or winter, I never tire of absorbing this vast landscape. From where I sit in writing this I have but to look out of my window and I see the Greylock range of mountains in the extreme northwest part of the State, thirty miles away, with "Old Saddle Back," the highest land in the State, as its crowning feature, under whose shadow lies lovely Williamstown, with its historic college. Were it not for my barn, looking through another window, the famed hills of southern Berkshire would greet my eyes. From my front door I look upon hills in Vermont, and a few steps along on my lawn enables my unassisted eyes to salute grand old Monadnock Mountain, sixty miles away in New Hampshire. Seated in my dining room, three times each day, I have an unbroken visual feast of the fatness or leanness of the land, from the southeast to the southwest, for forty or fifty miles, embracing the Blandford hills and village, with its tall-spired church. At the east, three miles, a range of hills fifty feet higher than I am just screens from my view the Holyoke and Mount Tom ranges and the intervening valley, but from the summit of these hills, to which I have driven scores of times, and, without leaving my wagon, I have seen at one outlook, in the south, the dome of the capitol at Hartford, Wachusett mountain at the east in Worcester County, and in the north, Monadnock, near Keene, New Hampshire, with seventy-five or eighty miles of the Connecticut River valley between. Between Northampton and Pittsfield the highway leads to many deep valleys and crosses many streams of considerable magnitude, power and, of what is of importance to me, trout. These streams all run to the south, and either to the Housatonic or Connecticut River. In winter this region is often a terrible place to live, but the summers are a little the longer and they are charming. It is here that I have located my theme, "The pleasures of farming."

Does farming pay? how to keep the boys at it; sheep-raising; the dairy; the care and management of horses; vegetables from the kitchen garden and for market; orchards and their crops; fertilizers, and can we afford to use them? and a large variety of kindred subjects are drawn upon by the State delegates and other speakers for their eloquence on such occasions as this, and I may extract something from them if anything is left, in my brief remarks to you, but my wish is to draw your attention from the mere profit to the pleasure of farming.

The problems, Does farming pay? Is life worth living? Is marriage a failure? involve the same conundrum, and it is not omitted in my contemplated theme, for I shall be confronted at the outset with another problem, What constitutes pleasure, or what is it? The miser attains it, or thinks he does, by hoarding his money, while the prodigal imagines he reaches the same result by squandering what others have saved for him. Many a sharp man, so termed, scrimps and denies himself through life with apparent relish, in order that some only son may inherit and add to the thousands left him. This heir no sooner inherits his father's property, saved at so much sacrifice of comfort, than he looks about for what are to him pleasant ways of dissipating it. What is one man's cure is another man's bane.

While it is generally conceded that every one is in pursuit of happiness, we have reason to fear that comparatively few arrive at a result that completely satisfies them. Do you know of any one who wants for nothing more? In these times of great individual or corporate wealth it would seem that some might be beyond all wants, but it is not so. Rich men occasionally retire from business on their wealth, but do you happen to know of any who ever retires from a desire to increase his wealth? Take the late A. T. Stewart, a man who began his business life by peddling Irish linens from a pack, and died childless, leaving millions to be fought for in endless courts. He was the only merchant in New York that I ever heard of who under any and all circumstances absolutely refused to compromise a debt, and I have reason to think he was an unhappy man. The present Astors, whose grandparents bought and sold pelts and shook out and aired them, almost within my memory, on the ground now covered by the great hotel bearing their name, are on the rack morning, noon and night for more real estate that will net them a fair interest on a new investment, and the same generation of Vanderbilts are at starvation point in pursuit of more miles of railroad that they can absorb. Transportation is their desire, and it is legitimate, as the founder of their great wealth, the "old commodore," was a stage driver. This is not said in derision, for the present Vanderbilts are large-hearted gentlemen; but what it is to some of us to buy or sell a yoke of oxen at a high or low figure, it is to them to secure an extension of their lines of railroad; the same in kind, only different in degree. A few years before Mr. Stewart's death, he built for himself a marble palace on Fifth Avenue. It was the wonder of New York and the envy of all architects; but some of our homes, even on the highest hills of Massachusetts, entertain more guests annually than did this one, and as pleasantly. The Vanderbilts have rival and more jolly establishments on the same avenue, and extravagant ones at the summer watering places, but whether in them, or in sailing the broad ocean in their magnificent private steam yachts, or flying across the continent in their own gilded trains, I do not believe they take a whit more comfort or pleasure than does the average small farmer among us. I doubt if any man has all he wants in this world, and these very rich men have real or imaginary unsupplied wants commensurate with their wealth the same as poorer persons do. The modest blue gentian flourishes to perfection in damp and dark spaces by the roadside; the banyan of India, and the redwood of Yosemite require more room. Wealth is not a guarantee against trouble or misfortune by any means. I have long since given up envying any one's riches or happiness.

Leaving individuals, let us look at manufacturers as a body. We hear of the fortunate ones, of those who are successful in securing a fortune, but who takes note of those who are not? With scores and hundreds of employees, with prices of material and product daily fluctuating, with styles ever changing, values depending more on fashion than on real merit, upon the condition of the money market, and this often hanging upon slight contingencies, upon the tariff, upon the foreign supply or demand, and, worst of all, the liability of strikes, what a life, harassed by fear and uncertainty, a manufacturer leads! Now and then one fastens on to a good thing, something that pays well in profit; everything seems to go easily and about of itself; but the owner will tell you that eternal vigilance is the price of it, and the first thing he knows some morning when he opens his mail his commission merchant, to whose mercy nearly all manufacturers are consigned, tells him that some other party is on the market with the same or better goods at a lower figure. Often when everything seems at its best a fire or a flood wipes everything out. If the manufacturers live such worried lives, how fares it with the employees? Better, I admit, in many instances; but to work at precisely the same kind of work day after day, year after year, and perhaps through a lifetime, without an hour's respite unless it is deducted from paid time, has always seemed to me little better than a mild form of prison life. I wonder if our "Highland" and "Hillside" farm boys would like to be bell rung out of their beds every morning in the year, or whistled out and in for an hour's nooning and again at the close of a long day, with never a rainy day for trouting, or a pleasant one for hunting, unless it is bought at so much an hour. Those who rise above the place of the common daily laborer are in the great minority. Occasionally one rises to be a foreman or superintendent of some department, but these are the exceptions. From the nature of the business, the great majority of operatives must remain near the foot of the ladder.

Let me turn for a moment to the merchants of our land. As the business of the world is carried on, the merchants are a necessary class. It is a very large one, an important element, but when you come to analyze it, what is it but a go-between between the producer and consumer? If you leave out an increased profit, I know of nothing that a merchant creates. I am not ready to think even that they could be dispensed with, but they could not live a day were it not for the producing farmers. The same is true of the manufacturing operatives, and the rule is good both ways. The farmers are entirely dependent upon non-producing consumers. Hence, every individual in this country being so absolutely dependent upon some other individual for his daily bread, what are we but a gigantic body of partners for life? And being so, why is not one branch of the total business quite as respectable as any other?

The manufacturer, by ingenious and intricate machinery, transforms the wool from the sheep's bodies or the cotton from the fields into fabrics of endless variety for the use of mankind; the merchant, adding his living to the goods, sells them to the consumer, while the farmer, with God's lavish kindness, has produced them. No one save the Almighty has created anything, but in creation and production I maintain that the farmer stands next to the Almighty.

I insist, therefore, upon the great respectability of farming as a means of living, and though I may have apparently strayed from my subject, I have been constantly near it in speaking of drawbacks to pleasure in other employments.

You will pardon me if I say that I passed twenty years of my life in New York. I must have been a dull scholar indeed not to have learned something in these my best years. Since then I have said again and again, and now repeat it, there is no large class of laboring men who work so hard as do the New York merchants, unless it be the merchants of the other large cities. I do not say the clerks, but was there ever one of them who did not aspire and strive to become himself a merchant? It is this incessant strife to that end that makes their life a struggle. No sooner are their services sold for one year than they are constantly anxious to know whether they can be negotiated for another year. The clerk's salary is usually equal to his value and is generally liberal. They dress well and are compelled to. Their complexion and white hands are a perpetual delight to the country girls and the envy of every country lad, but let me tell these same young farmers that I went from a farm to New York when I was twenty years old, and I never knew what it was to be tired out until I was on my feet from morning until often late at night tramping on a floor two hundred and seventy feet deep, to say nothing of the frequent running up and down long flights of stairs. There were no elevators in those days. This was a small store compared with what exist now, though one of the largest then. It was a relief to be sent out on an errand and to get a rest on the sidewalk, yet now when I look back upon that period in my life and contrast it with that of my employers and with my own experience subsequently when I was also an employer, I think my easiest days were when my work was laid out for me. It is much harder to do a mercantile business now than it was then. In fact, it is hardly possible to do a small business successfully now in the cities. It must be of enormous proportions to have a fair chance of moderate success, and this entails its proportion of added cares and strain upon the principals.

The great bulk of merchandise is now sold on the road by commercial travellers. To keep these expensive men at work great duplicate stocks of goods have to be kept. The best friend I have in the world is one who was a boy from my own neighborhood. For more than forty years he has been a successful manufacturing jewelry merchant in New York City, and he tells me that the details and perplexities of business have been many times doubled in his experience. His favorite expression is, "I shall die with my nose on the grindstone," and he will.

The young men in our country towns who see these travelling salesmen that I have just spoken of, only at the stores or hotels, see in them a well-dressed, self-assured lot of fellows, who seem to have a mighty easy berth. As a class they are eminently respectable, and they have to be to secure and maintain their responsible positions; but there isn't one of them but what will tell you his is a dog's life, and so it is. No loitering, no rainy days for him. His work is laid out for him arbitrarily for every day and it must be done faithfully at all reasonable hazard, if he means to be a valuable man. They are the first to arrive at hotels in the day and the last to leave them at night, so much of their travel on long trips being made on the trains in the night. Go into Cooley's hotel in Springfield any night in the week except Saturday or Sunday, every man who isn't reading or playing whist is copying his day's orders to send home, and at the long writing tables there isn't space enough for any one else until late in the evening. I have brought this class of young men to the front conspicuously to contrast their occupation with that of a similar class of men by nature, whose conditions and surroundings have located them on farms instead of in factories or in stores, and I might continue it indefinitely, to the advantage of the latter class.

I contend that the farmer's life is the easiest and most pleasant, because there is less intense brain work in it. Statistics prove that there is less nervous prostration, less loss of brain power, and fewer suicides among farmers than in any other equally large class of working men. Do not think I am thinking lightly of the need of having brains in farming or disparaging the intelligence of farmers, for it is a well-known fact that a great majority of our most intelligent men in every branch of business came from our farms. But brain work almost always includes night work. Most of our literature, whether for books or newspapers, is written while farmers sleep. The merchant tosses on a sleepless bed, contriving how he is to meet maturing notes or hold and increase his trade. The manufacturer is tortured day and night over poor sales, a lack or excess of water, disabled machinery and how to get new, and a thousand perplexities that the farmer has not the least idea of. As a class, we farmers go to bed to rest and sleep, and to recuperate for another day's work. Suppose it rains the next day. All merchants will tell you a rainy day is never fully made up. We don't miss it, and quite likely it is what we have been praying for. If there is a wedding or a funeral to be attended we find time for both. We know that our business, the raising of stock or crops, goes on just the same in the night as in the day, Sundays included. *Our* stores and factories are not closed once in the entire year, and how many nights in the summer are we entertained by hearing the refreshing rain fall on our roofs. Even the worst snow-storms in the winter are welcome, for they insure the drawing of the indispensable ice, the wood, the crop of hay next year, and the merry sleigh ride. The long winter evenings furnish time for reading.

I am not unaware that we suffer heavy aggregate losses by death in our stock and in failures of crops, but many of us are not specialists in any one line, and if one crop fails, another does not. To myself there is great pleasure in being next to the Creator in creating something, either from the earth or in raising and caring for stock. In our pursuits we are happily of diversified tastes. One man inclines his attention to earth crops ; another one to cattle or horses, sheep or swine, and some compass all of these branches of farming, and if one is moderately successful in them there is a degree of satisfaction and just pride united in the endeavor that eclipses the ordinary sharp and close dealing that seems inevitable in any other vocation that employs capital.

I have given some little attention to sheep for the last few years. Beginning with twenty-five merino ewes, I have now over fifty of their descendants, largely Southdown or Hampshire Down, among them some noble animals, and some of the originals. I have sold over 300 early lambs at profitable prices, and still improved and increased my little herd. Last season it gave me great pleasure to show more than forty-five lambs, not losing any that or the previous year. This year I ought to have more than sixty. Now, any one with a small farm, not otherwise overstocked, can do the same, and if he gets anything but pleasure from it he will be less fortunate than I have been. The dogs are the worst and about the only enemy the sheep raiser has. Given good sheep to start with, a good pasture, and warm stables for early lambs, there is great pleasure in raising sheep. I am not much of a farmer and a tolerably poor specimen of a practical one, as I know you know, but such as I am, I get more pleasure out of my farm life than I did out of a not unsuccessful career in New York City. A pair of twin heifer calves which I found in my cow-stable one day did not make me unhappy, nor has the raising of them to milch cows made me miserable. I am proud and get pleasure in leading such stock to our annual cattle show. I have also had great pleasure in raising a pair of matched horses from suckling colts to six years of age, and to a weight of precisely 1,150 pounds each. One of them had to be reared in infancy on a bottle, and being now a fine animal, I feel as though something had been created from almost nothing. It is nothing but pleasure to ride after them, and a lively spin behind them is better than "Black Crook."

But of all the sources of pleasure which I have from my farm, I put the garden in the front. Beginning work in it in the last of March, often digging through snow to do it, I find pleasant occupation for some part of every day until the crops are ready for the table. Once planted, I can take care of the garden without seriously interfering with other work. An early hour in the morning, a late one at close of the day after the field work is done, are generally sufficient; but if more time is demanded, it is not wasted, for an abundance of early garden vegetables is as desirable and profitable as any crop on the farm. I am not situated with facilities for selling my garden products, but I know what the pleasure is of giving away quantities of them. It is not half the work to keep a garden always in order that it is to do it periodically or at infrequent intervals, and the crop returns are best under constant care. When I can have on my sterile hilltop, radishes, lettuce and cucumbers to give away early in June, and hundreds of tomato plants a little later, then my pleasure in farming comes in. To do this with tolerable certainty, with no hot-houses or indoor planting, you must begin your garden the fall before, but any boy fifteen years old can do it anywhere in the State, and if he wishes I will tell him how.

We all have more or less desire to beat our neighbors. It is not a very bad ambition in the line on which I am speaking. Peas can be had about June 20 as well as a month or two later, and I always plant the latest kinds as early as the earliest, because they are the best and will not under any circumstances be ready for the table until the early ones are gone.

In field crops, when I can take the first premium on corn, which I have many times done, against many worthy competitors who farm under more favorable auspices, I don't go home feeling very unhappy. It is a distinction that I am proud of. But, after all, I get the most of my pleasure from the fact that the best corn at our fair has been raised on my dearly loved hilltop, rather than in the warm valleys that are more favored in natural fertility and climate.

I pity the boy who has to do barn chores and does not like to. He may not know it, but it is a very important part of his education if he expects to be a successful farmer. Chores can be made pleasant work by the owner of the farm, if he makes pleasant work of it himself. To have a barn full of stock that is dependent upon you for its care and keeping is as humanizing as is the care of the family, and the great law of kindness can be as well taught and learned in the barn as in the house. The farm boy soon comes to know that all of the stock must be fed, watered and taken care of as certainly as himself, and when this depends on him, there is a responsibility comes with it that should be made pleasant to him. At the present day no good farmer has a cold barn or stable, and when a boy works there he should do so comfortably and pleasantly. To do this he should be taught to keep the barn clean and wholesome, and his good taste and pride should be encouraged in that direction. A clean barn indicates a clean character. Before new hay is put in the barn, the cobwebs from overhead and all floors of vacant bays and scaffolds should be swept clean. The new hay should be mowed just in line with the barn floor, not projecting over it, nor shrinking from it. When it is all in, the mows should be carefully raked down till they are straight and even, and then don't let the first man that drives in your barn hitch his horse where he will eat out a cavern to be an eyesore all winter. Sweep the barn floor as often as is necessary to have it always clean. To have unused hay on it in good shape for feeding is not uncleanly, but to have it scattered around to be trodden on by man and beast is. A clean barn is always a joy to its owner, and every one who enters it will say, "How nice this is." Every barn to be perfect needs a good-sized, pleasant, well-lighted, finished room; one that you can have a fire in. Hundreds of persons, including ladies of "high degree," visit my "crib" in my barn, annually, who do not enter my house. It is a good place to read, write or visit as well as to mend or dry blankets. It is filled with pictures and *bric-a-brac*. Besides such a room, a workshop is indispensable. In it there should be a long, heavy work-bench with two vises, one for iron and one for wood work, and with a few tools it is surprising how many things can be made or repaired there. The shop is the best place on the farm to teach a boy to put things in their places. Nothing annoys me more when I want a tool than not to be able to put my hand on it at once. The habit of putting everything where it belongs is one of the first things to be taught any farm boy. It saves a vast amount of time, vexation and "cuss words." All tools needed on the farm or in the shop should be owned by the farmer, not borrowed. A good farmer will rather lend than borrow, and if properly taken care of and housed, most of the tools, from a hammer to an ox cart, will last a lifetime. A half hogshead in its purchased state is perishable, but paint it and hoop it with old wagon tires and you have it to lend to all your neighbors forever, every time they kill their hogs, and to go after when you want to kill your own.

Pages might be written upon the pleasures of feeding stock and seeing it improve under kind treatment in warm quarters. It is a great pleasure to me, in the howling storms that often occur in my region, with the mercury at zero or below, to know when I go to my bed that all of my stock is as warm and comfortable as I am.

There is one thing about some of our farms that has neither pleasure nor humanity in it, and that is in watering stock at distant streams or springs. Where water has to be pumped into open troughs in open barn yards, that is bad enough, but to force cattle out in storms and deep snows to seek for it is not only inhuman but wasteful to the owner. There are hundreds of farms where, simply by lengthening the barn pump, water can be pumped into a tank in the cow stable, where it won't freeze, and from there for $5 it can be distributed all over the barn. All stock can be easily taught to come to you when in pasture at the sound of a whistle. It is heard farther than the human voice and saves miles of travel.

Among the pleasantest features of farm life is the planting of shade and fruit trees, including grafting the latter. Together they are an exhaustless source of pleasure and profit. I count among my priceless treasures an elm tree that my father planted about seventy years ago in front of his and now my home. Its topmost branches receive the earliest kisses of the summer morning sun. In them the first robin and bluebird cheer my heart in vigorously and joyously proclaiming that spring is again at my threshold bursting the bolts of winter, and inviting me to the delights of hastening summer. It towers above everything in my neighborhood, and by it I can locate my home from many distant places. For seventy years it has protected me from summer's heat, and on how many winter nights of hurricane gales has it roared its lullaby in my sleep. Twice it has received the lightning's blast. Once it sacrificed limb upon limb when my father's house and my birth-place was devoured by fire. But generous nature hurries to repair all such ravages, and it stands to-day my father's most precious monument, in glorious form and symmetry. Long may it wave! Many others have been added to it until the shade trees of my own village make it a most desirable summer residence. A clean lawn, with plenty of shade trees outdoors, plenty of newspapers, books and pictures indoors, and a decent disposition will make any home pleasant.

In closing, permit me to say that I think that in farm work especially, whether in the field or stable, nothing is worth doing at all unless it is well done. Such work always brings pleasure, and generally some profit. The other kind brings neither.

# THE RESTORATION OF EXHAUSTED FARMS BY PRACTICAL METHODS.

BY ELBRIDGE CUSHMAN OF LAKEVILLE.

What is an exhausted farm? This, like many another, is a question more easily asked than satisfactorily answered. If we were to question a number of practical men, we should expect a wide range of answers. Some would picture continued robbery, where the rich treasures of the soil had been carried away by annual croppings without an adequate return of plant food; while others might cite instances of neglect and careless husbandry, where nature was o'ershadowing the bounds of cultivation and again asserting her right to supreme control. Still others might point to localities naturally poor. Such spots are found almost everywhere, and, like the unfortunate of our race, are always with us. Early history teaches us that even before the Anglo-Saxon possessed these shores, the "red man," in the cultivation of his patches of "Indian corn," had found it for his advantage to draw upon the rivers and the ocean for fertilizing material. But it is our purpose in this connection to speak more particularly of those farms that have known better days, the "old homesteads," where, within the memory of those now living, peace, plenty and good cheer did abound.

It has been the writer's lot to own and cultivate four different farms, many of the fields upon either of which might properly be termed exhausted lands. Former generations had successively cropped them with special crops, without regard to rotation or fertilization, until they had ceased to yield remunerative returns. It has been our life work to restore these fields and farms to something of their former fertility and productiveness. From our standpoint the work has been attended with a fair degree of success, — certainly it has ever been an increasing pleasure, — and if from the "lamp of experience" we may light the pathway of another, who may be laying hold of one of these waste places to make it "bud and blossom like the rose," then truly our work will be most gratifying.

To the many who, having become weary with the close application, long hours and exacting demands of manufacture and trade, and possessing, it may be, a small capital with which they desire to establish homes and become owners of a few acres, — to such we say, make haste slowly; nevertheless, commence at once.

First decide towards what branch of farm husbandry your tastes and inclinations would lead you, as these should have a controlling influence in the selection of your future home. Should you incline towards orcharding or the cultivation of the smaller fruits, together with the keeping of poultry, sheep, or swine, a higher, dryer and more arable soil, one more responsive and easier of cultivation, should be selected than if the cultivation of the grasses for dairy purposes is contemplated. And, further, in deciding upon location, the crops to be cultivated should have due influence. If perishable articles are to be the products of the farm, then a location near some good market will be more essential, while, on the other hand, products with keeping qualities may seek a market long distances from the scenes of their production. But, first of all, healthfulness should be the prime consideration. Quick and thorough drainage around the buildings is all-essential. Where this could not be secured we should not consider the premises worth reclaiming. In fact, a place where water stands in pools either around or under the farm buildings, at any season of the year, we should shun as we would a pest-house.

Again, it will by no means follow that social advantages must be sacrificed to secure a rural home. Hundreds of desirable farms scattered over New England are upon the market awaiting customers on most reasonable terms. Many of them are in neighborhoods where the church bell rings out upon the Sabbath morn, the school-house is in sight, and where stores, depot, post-office and kind neighbors are all within reasonable and convenient distances, thus combining all the real advantages of urban life with the quiet of a country home. Farms intended for *homes* should never be purchased solely because they are thought to be cheap; for, if possible, such selections should be made that not only the owner but his family as well will be satisfied with their surroundings, and be pleased to call the place their *home*. Then it will be no burden to add improvement to improvement, all working together towards the ideal result.

One undertaking the reclaiming of an exhausted farm must not expect to transform it to his mind in a day, or a single year even; the changes must be gradual. In short it is the work of a lifetime, a never-ending labor, and, as all the desired improvements cannot be accomplished at once, neither are all the expenses to be met at a single payment. As in every other undertaking, some well-matured plan or system should be adopted. We dwell at some length on these preliminary points from the fact that we have known several instances where the inexperienced have made sad failures by purchasing cheap farms, supposed to be exhausted, when in point of fact they were naturally poor and rocky, — made so on the morn of creation and never intended to be cultivated. A mistake was made when they were cleared of their forest growth.

Having secured a location to one's mind, with natural advantages and surroundings adapting it for the purposes in view, the first object to claim attention will be the house; and here not always the most expensive outlays bring the greatest comforts. Yet a few essentials there are in order that a house may truly be a home. There must be ample opportunity for the sunlight to reach the house, with plenty of windows through which it may enter, to warm and cheer the rooms occupied by the family. We can call to mind a score of farmhouses, familiar to our youth, where the work and living rooms were on the north side of the house, with one or possibly two small windows, with not an aperture through which a ray of sunshine might enter, unless carried in upon the countenances of the farmer's wife and daughters. An abundance of pure water should be convenient and accessible at all times. With the many modern contrivances for conducting water into farm buildings, no farm can truly be said to be reclaimed while the old well, so handy to the back door, receives the drainage of the buildings and at the same time furnishes the water supply for the family. Sanitary laws demand that not only shall the water used in our houses be sweet and pure, free from all the contaminations of drainage, but also that for our farm stock as well. Again, such improvements necessitate ample sewers and drains to carry all waste to a safe distance from our dwellings. These are matters of primary importance and have almost invariably been neglected upon our exhausted farms. Improvements of this character are sure to increase the market value of the premises more than cost, but as requisites to a home they are invaluable.

We have seen the old-style high double houses, with their oaken frames, having stood squarely upon their granite foundations for nearly a century perhaps — stern reminders of the upright character of their builders — robbed of their cold, cheerless, castle-like appearance by the expenditure of a few hundred dollars in throwing around them verandas and conservatories, thus transforming them into most lovely and attractive homes.

The growing of fruit trees requires time and patience, and should receive attention among the earliest improvements upon the farm. If orcharding is not to be a specialty, a single acre, properly located and set with the best varieties, will add a beauty as well as a cash value to the farm. Shade and ornamental trees can also be set in such places, and in such varieties as will add a charm and beauty to the home surroundings, which, considered by the lowest possible criterion — a cash value — would pay many fold. It is not necessary or always wise to bring trees from long distances with foreign names and unknown habits. Native trees, indigenous to the soil, properly arranged and grouped, will be more attractive, especially when taking into account the added beauty of healthy and vigorous growth. This work may be quite inexpensive and can be done in seasons of comparative leisure. The deciduous trees can be transplanted in the fall and the evergreens in the late springtime. It is well to bear in mind that they are not desirable in too close proximity to our dwellings, but are of greater value in backgrounds and on exposed locations.

To bring a farm into condition to correspond to modern ideas it will be necessary to change or remove entirely many of the old cross walls and fences, as well as those by the roadside. Modern methods and improved farm machinery call for larger fields, free from all obstructions. Our fathers spent fortunes in fencing the roads and highways, while to-day wise laws relieve us of that onerous burden. This removing of obstructions, of every character, to a freer cultivation is a work that may be done as opportunities offer. Yet here again definite plans should be kept constantly in view, and the whole system of improvements designed from the commencement. If lands are to be drained, old walls and surface stones can often be utilized in the construction of such drains, and thus a double object be accomplished.

It has been said with truth that a child's mind and character are largely influenced by the scenery and natural surroundings of its home. There is no doubt that in manhood we leave the impress of our minds upon the acres that we have possessed. I remember riding across our county in my youth to visit the farm and home of the "great expounder of the Constitution." In later years I have read his life, studied him as a statesman and admired his genius; but it was when a boy, and viewing the large fields in his great estate, that I formed my high ideal of the true greatness of Daniel Webster. Thus it may be seen that in the restoration of our neglected farms the beauty of the landscape should no longer be ignored, but rather receive the earliest attention of the owner.

Modern agriculture is imperative in its demands for an abundant fertility in the soils cultivated. Our fathers, cultivating a virgin soil, with cheap labor, and with high prices for products, might ignore this question, but to-day how different the conditions. Compelled to cultivate a soil depleted in a measure of its former fertility, paying the highest prices of any nation on earth for agricultural labor, and producing crops often sold in the cheapest markets of the world, we are obliged to avail ourselves of every modern improvement, to intensify our farming in order to obtain the best possible results.

The fertility of our exhausted lands may be restored, or increased in two practicable ways, viz.: By feeding farm stock and applying their voidings to the soil, or by buying commercial fertilizers and applying them directly upon our fields. The farmer's own particular circumstances should decide his method. Whichever method is adopted we are co-workers with nature. And here I would remark that the results will depend very little upon luck and in no degree upon magic, but success will come only through a proper combination of "brain and brawn."

Years ago I read a little book upon "High Farming without Manure." The object of the author evidently was to show that something could be grown from nothing. In later years I have seen too many misled by this fallacy. Here I call to mind a little story heard when a boy, yet it has never been forgotten. The custom of an eastern country was that after planting the seed in the soil the priest should go forth upon the fields and invoke the blessings of Heaven for an abundant harvest. Coming to the boundaries of one field, he looked upon the surface and turned away in silence. When asked his reason he said: "It is no use to ask for a blessing unless they put on more manure." We must bear in mind that something of the same laws that pertain to the feeding of our farm stock apply to the feeding of farm crops. They all eat in their own peculiar way. The food of all must be prepared and placed within reach of each, according to its kind, that it may be received and assimilated. In speaking of increasing the fertility of lands, the mistaken idea sometimes gains possession that plant food can be made or created, while the most that we can do is to save, accumulate, utilize. Absorbents must be freely used. Further than that we never have realized profit to compensate for the labor in interchanging soils for fertilizing purposes from one locality to another upon the farm. A more economical method may be found to enrich the high lands, while the low lands, if properly drained, will in time require all their plant food where deposited by nature. On many farms there are quite extensive bogs, producing only the coarsest and most innutritious grasses; yet there are present rich deposits of plant food, the accumulations of ages, annual deposits from the surrounding hillsides, lying dormant and unproductive on account of the presence of water. If the location will admit, surface or underdrains can be constructed, when the character and producing capacity of the land will be changed as by magic. In improvements of this kind experience is of great value. The service of an engineer may sometimes be required to determine inclination of land and amount of fall, although if water runs in natural channels it may safely be inferred that there is fall enough for practical drainage.

In reclaiming the higher, dryer portions of the farm, the fields adapted for the cultivation of the cereals, plant food must be bought in some form and brought upon the farm; but it should be a gradual process under any method. As the hand of greed has been staid when attempting to rob the soil of all its stores at a single cropping, so on the other hand by no practicable method can we restore abundant fertility by a single application of plant food. It may seem paradoxical, yet the only practical method we know is by continual and profitable cropping, carrying off an abundance, yet returning more abundantly. Thus it is evident that those crops must be raised, having a market value, which insure a profit over the cost of production. If the crops can be consumed upon the farm, securing a still greater profit, this too may further the end in view. Should the owner decide upon the keeping of farm stock and make dairying his specialty, then each individual cow must return a cash value for all the provender she consumes and something more, or she must be weeded out of the herd. Thus the voidings will constantly add to the value and fertility of the farm.

It is a mistaken idea that nothing should be sold from the farm for fear of impoverishing it. In a certain sense the farmer must consider himself a manufacturer; his farm is to him a factory or workshop into or upon which he carries his raw material (plant food) and working with nature he produces an article of commerce, which he may sell in the markets at a profit. It is his legitimate business to buy in the markets certain elements, either simple or in combination, and sell them in other forms and combinations. So, again, in a sense he becomes a merchant, constantly buying and selling with the hope of gain. To be successful he must know something of the elements and their cost that compose a unit of his production. When we know that we are producing our specialty at a profit we shall have confidence to enrich our fields and further enlarge our business.

Successful farmers as a rule are specialists, producing some one principal crop from which the money revenue of the farm will be derived. Their fields will be fertilized and cultivated with a view to the demands of this special crop. And here we meet the most difficult and perplexing question that confronts the farmer — how to feed the different varieties of crops growing upon the different soils of his farm. The capitalist, with abundant means at command, impatient with delays, looking for immediate results, may by a few excessive applications of plant food bring an exhausted field to a fair degree of fertility; but with the farmer of limited means at command this would not be the most profitable method.

We have learned that in feeding farm stock the most practical method is to feed just the quality and quantity required, and only such varieties should be purchased as we believe to be wanting in our home-grown supply. The same rule applies with equal force to fertilizing for our farm crops. As all classes of farm stock do not require at all times and under all conditions the same kinds and quantities of food, so we find the same laws governing the growth and nourishment of vegetables and cereals. Happily we are not compelled to grope our way darkly along these intricate paths. Fifty experiment stations, supported by the liberal hand of a government that has never turned a deaf ear to the calls of agriculture, are scattered through every State of our Union, experimenting upon all these questions and furnishing results for the mere asking to every farmer in the land.

Chemists tell us that of all the elements entering into the structure and composition of our farm crops our soils lack only three, viz.: Phosphoric acid, potash and nitrogen. Now, while it may not be absolutely essential that every farmer should be a chemist, yet it is essential that he should be on *speaking terms* with these elements, factors so important to his success. Probably there is no farm or field once productive that has been entirely robbed of either or all of these elements, and could we know the exact amount lying dormant and inactive our acres would rise in our estimation while calculating their market value. So it seems that the question of fertilization consists in a scientific application to the soil of just those elements which, in combination with those already present, will give the crop food for its fullest development.

The three essential elements named are found in the voidings of animals, in proportions governed largely by the food consumed; and whether this main source of plant food is the cheaper under all circumstances must be determined by local conditions. The same elements are found on sale in open market, quoted in the price current, with prices influenced by supply and demand, the same as the food for our farm stock. I believe in fertilizing by both methods. I have bought each year, for a number of years, both stable manure and chemical fertilizers in quite large quantities, and these, in connection with the manure from a herd of dairy stock, have in the last fifteen years increased the producing capacity of the farm fourfold, notwithstanding the fact that we have yearly made large drafts upon the farm by selling milk, hay and vegetables. Experience has taught me, however, that excepting for special purposes plant food may be found in commercial forms cheaper than in stable manures, and can be more scientifically applied. Other conditions and surroundings might reverse these conclusions.

The keeping of certain kinds of farm stock, such as poultry, swine and sheep, seems to be peculiarly adapted to go hand in hand with orcharding and the cultivation of small fruits. I call to mind a number of acquaintances who have paid for their homes and reared a family, with all the comforts as well as many of the luxuries of life, with no other income except that derived from this industry. It is well known that sheep and swine, and even poultry, when confined within proper enclosures, are especially adapted for the eradication of almost every variety of wild and innutritious vegetation, thus assisting in preparing the ground for the plough, or even for an application of seed without expense of further cultivation. In these particulars I speak more from observation than experience. But I know an orchard in a most healthy condition, where no fertilizing material has been applied since the setting of the trees, except the droppings from the poultry kept in the enclosure at the rate of about seventy-five to the acre. Another stocks his orchard with sheep, where they remain during the year. The hay and grain fed during winter more than compensates the soil for the drain caused by the annual crop. Thus an added fertility is secured and a twofold profit realized from the land, with little or no expense of cultivation. I have practised for years the pasturing of hogs and horses a part of the season in my orchard, and to compensate for what was carried off I have made annual applications of potash and phosphoric acid. A person making a specialty of fruit culture in connection with keeping the class of farm stock mentioned need never purchase fertilizers. But in the cultivation of the smaller fruits and vegetables, land in a high state of cultivation will be required.

In attempting any practical method for the restoration of exhausted fertility to our fields we must at the start free our minds of the idea that we can put into the soil and take out certain elements and quantities of plant food at will, or that we can take at a single cropping just what we have applied. In water culture this might be possible; in soil culture it is not. We must always leave a large amount of plant food in the soil and in the roots of the crop. As a rule the largest crop is the cheapest. Thus economy would dictate the most liberal fertilization. Then it must be remembered that there may be already in the soil enough of one or even two of the essential elements to grow the required or ideal crop; if so, it would be placing capital where it would yield no immediate returns to apply more of these elements. Crops are fastidious in their tastes and will receive their food only in well-balanced rations.

Those of us engaged in the feeding and care of dairy stock have read and thought much about the proper balancing of the different ingredients in their diet. Competition has compelled us to learn and practice something of the scientific feeding of farm stock. We know that when an excess of carbohydrates are fed a loss is incurred, while if the diet be largely of albuminoids the health of the animal will be impaired, and that the nutritive ratio of the diet must be changed to correspond somewhat with the season as well as the age and requirements of the animal. Is it less essential that we should study the requirements of our crops and furnish their food in the proportions required?

Right here we must look again to our experiment stations and to the scientist for those general rules that may start us in our field of investigation. Yet there are many important truths, facts essential to success, purely local, it may be, in their character; these must be learned by individual experiment.

It is a mistaken idea that the chemist can tell us all about our own farms or how much of certain elements are to be applied to any particular soil to produce a given crop. The small sample of soil that a chemist would undertake to analize could not fairly represent the field or farm from which it was taken. So we say the farmer must go forth upon his fields as a student of nature, to be taught by observation and actual experiment. He must apply each of the essential elements of plant food, simple and in combinations, in different portions of his fields, as he may discover a difference in the wants of the soil. He must note with the greatest care all the influences that may affect his experiment. He may select certain square rods in different parts of his cultivated field and apply upon one and thoroughly incorporate in the soil a certain amount of nitrate of soda, upon another an equal amount of fine ground bone, a third should receive the same of muriate of potash, and so on through various combinations of these elements, always keeping strict account of weight or cost. Another method of applying these elements, we have found very convenient among crops planted in rows, is, after the plants are large enough to be seen, to commence at a certain bound and thoroughly fork in a certain amount of one of the elements between three rows for a certain distance, then skip three rows and take another element, and so on through all the combinations, making a careful record where each is located. Another and sometimes more convenient method is by tub culture. A number of large tubs, half barrels, for instance, are placed in a convenient location and filled with soil from the field we wish to experiment with, and the desired amount of these elements mixed with the soil in the tubs, and any crop desired planted. Here moisture may be controlled at will, and its effect upon the different fertilizers noted. These experiments should be tried upon different soils of the farm and upon different crops. The results from one experiment will not be sufficient; they should be continued through a series of years and under varied circumstances and conditions, until in the course of time the farmer may come to know something of the requirements of his own particular soil. Then may he exclaim with the poet: —

> "Nature is to me a living thing,
> Food to the heart and beauty to the eye;
> These plants, these flow'rs, the autumn's mellow sky,
> Awake the moral thought and sympathy."

While, in addition to knowledge gained by these experiments, he will learn much of value from the experiments and investigations of others in regard to the composition and value of the different brands of plant food in the market as well as of the chemical composition of his crops, he must never expect to master the whole book of nature. After a lifetime of careful investigation he may well doubt his ability to advise another, for in the end he must realize with the great philosopher that he has been able to gather only a few pebbles upon the shore of the great ocean of knowledge. But he will become more and more convinced that farming, like war, can never be learned from books alone, but rather by actual conflicts in the field. To reclaim the thousands of New England hillside farms that have been allowed to decline, to bring agriculture into the fore-front among the gainful industries engaging the attention of our people, we must rear a class of intelligent men and women, educated both in the schools and upon the farm. They must be both capitalists and laborers and must adapt a new and an intensified agriculture to the soil and climate of the section. While in the past the agricultural prosperity of other more fertile sections of our country may have overshadowed New

England, we believe we can discern the dawn of a brighter day. We have many reasons for the fullest faith and confidence in the future of our farm homes, and believe that their prospects are growing brighter and brighter with each returning year. So, with no regrets for the choice of our life work, we cheerfully give the encouraging word to the young and say, Go forth without fear or hesitation, possess the lands once occupied by the fathers, where practical ideas, worked out by willing hands, guided and assisted by modern improvements and modern developments, may yield abundant harvests, while the most practical result of all may be an independent, happy life spent in a quiet rural home.

# DIRECTORY

OF THE

# *Agricultural and Similar Organizations in the State.*

February, 1894.

# STATE BOARD OF AGRICULTURE, 1894.

## Members ex Officio.

HIS EXCELLENCY FREDERIC T. GREENHALGE.
HIS HONOR ROGER WOLCOTT.
HON. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, PH.D., LL.D., *Chemist of the Board.*

## Members appointed by the Governor and Council.

| | Term Expires. |
|---|---|
| D. A. HORTON of Northampton, | 1895 |
| JAMES S. GRINNELL of Greenfield, | 1896 |
| SPRAGUE S. STETSON of Lakeville, | 1897 |

## Members chosen by the Incorporated Societies.

| | | |
|---|---|---|
| *Amesbury and Salisbury (Agr't and Hort'l),* | F. W. SARGENT of Amesbury, | 1897 |
| *Attleborough (Agr'l Assoc'n),* | ISAAC ALGER of Attleborough, | 1897 |
| *Barnstable County,* | JOHN BURSLEY of West Barnstable, | 1895 |
| *Berkshire,* | SAMUEL M. RAYMOND of Hinsdale, | 1897 |
| *Blackstone Valley,* | HENRY A. COOK of Northbridge (P. O. Whitinsville), | 1897 |
| *Bristol County,* | N. W. SHAW of North Raynham, | 1896 |
| *Deerfield Valley,* | CHAS. E. WARD of Buckland, | 1896 |
| *Eastern Hampden,* | W. M. TUCKER of Monson, | 1897 |
| *Essex,* | F. H. APPLETON of Peabody (P O.Lynnfield), | 1896 |
| *Franklin County,* | J. C. NEWHALL of Conway, | 1895 |
| *Hampden,* | F. E. CLARK of Wilbraham, | 1897 |
| *Hampshire,* | L. W. WEST of Hadley, | 1895 |
| *Hampshire, Franklin and Hampden,* | C. B. LYMAN of Southampton, | 1897 |
| *Highland,* | H. A. BARTON, JR., of Dalton, | 1896 |
| *Hillside,* | WM. BANCROFT of Chesterfield, | 1896 |
| *Hingham (Agr'l and Hort'l),* | EDMUND HERSEY of Hingham, | 1897 |
| *Hoosac Valley,* | WM. H. GOVE of North Adams (P. O. Blackinton), | 1897 |
| *Housatonic,* | F. A. PALMER of Stockbridge, | 1897 |
| *Marshfield (Agr'l and Hort'l),* | JOHN H. BOURNE of Marshfield, | 1897 |
| *Martha's Vineyard,* | H. G. NORTON of West Tisbury, | 1895 |
| *Massachusetts Horticultural,* | E. W. WOOD of West Newton, | 1897 |
| *Middlesex North,* | A. C. VARNUM of Lowell, | 1895 |
| *Middlesex South,* | ISAAC DAMON of Wayland (P.O. Cochituate), | 1896 |
| *Nantucket,* | J. S. APPLETON, JR., of Nantucket, | 1897 |
| *Oxford,* | JOHN E. KIMBALL of Oxford, | 1895 |
| *Plymouth County,* | AUGUSTUS PRATT of North Middleborough, | 1896 |
| *Spencer (Far's and Mech's Assoc'n),* | EDWARD WARREN of Leicester (P. O. Spencer), | 1895 |
| *Union (Agr'l and Hort'l),* | G. C. ROWLEY of Blandford, | 1895 |
| *Weymouth (Agr'l and Ind'l),* | QUINCY L. REED of South Weymouth, | 1897 |
| *Worcester,* | C. L. HARTSHORN of Worcester, | 1896 |
| *Worcester East,* | W. A. KILBOURN of South Lancaster, | 1897 |
| *Worcester North,* | GEORGE CRUICKSHANKS of Fitchburg, | 1896 |
| *Worcester North-west (Agr'l and Mech'l),* | WM. H. BOWKER of Boston, | 1895 |
| *Worcester South,* | G. L. CLEMENCE of Southbridge (P. O. Globe Village), | 1895 |
| *Worcester County West,* | E. A. HARWOOD of North Brookfield, | 1896 |

# ORGANIZATION OF THE BOARD.

## OFFICERS.

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| *President*, . . . | His Excellency FREDERIC T. GREENHALGE, *Ex Officio.* |
| *1st Vice-President*, . | JAMES S. GRINNELL of Greenfield. |
| *2d Vice-President*, . | FRANCIS H. APPLETON of Peabody. |
| *Secretary*, . . . | WM. R. SESSIONS of Hampden.<br>Office, Commonwealth Building, Boston. |

## Members Board of Control State Agricultural Experiment Station.

Messrs. Wm. H. Bowker of Boston and C. L. Hartshorn of Worcester.

## COMMITTEES.

### Executive Committee.

Messrs E. W. Wood of West Newton.
Edmund Hersey of Hingham.
Wm. Bancroft of Chesterfield.
C. L. Hartshorn of Worcester.
A. C. Varnum of Lowell.
Wm. H. Bowker of Boston.
Francis H. Appleton of Peabody.

### Committee on Domestic Animals and Sanitation.

Messrs. Wm. Bancroft of Chesterfield.
W. A. Kilbourn of Lancaster.
Isaac Damon of Wayland.
W. M. Tucker of Monson.
G. C. Rowley of Blandford.

### Committee on Dairy Bureau and Agricultural Products.

Messrs. C. L. Hartshorn of Worcester.
D. A. Horton of Northampton.
Geo. L. Clemence of Southbridge.
J. C. Newhall of Conway.
F. A. Palmer of Stockbridge.

### Committee on Experiments and Station Work.

Messrs. Wm. H. Bowker of Boston.
C. L. Hartshorn of Worcester.
L. W. West of Hadley.
C. E. Ward of Buckland.
H. A. Cook of Northbridge.

### Committee on Agricultural Societies.

Messrs. Edmund Hersey of Hingham.
Q. L. Reed of Weymouth.
N. W. Shaw of Raynham.
F. E. Clark of Wilbraham.
W. H. Gove of North Adams.

### Committee on Gypsy Moth, Insects and Birds.

Messrs. E. W. Wood of West Newton.
Francis H. Appleton of Peabody.
Wm. H. Bowker of Boston.
Augustus Pratt of Middleborough.
F. W. Sargent of Amesbury.

### Committee on Agricultural College and Education.

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Geo. Cruickshanks of Fitchburg.
E. A. Harwood of North Brookfield.
J. E. Kimball of Oxford.
John Bursley of Barnstable.

### Committee on Forestry, Roads and Roadside Improvements.

Messrs. Francis H. Appleton of Peabody.
Edward Warren of Leicester.
J. H. Bourne of Marshfield.
Isaac Alger of Attleborough.
S. M. Raymond of Hinsdale.

The Secretary is a member, *ex officio*, of each of the above committees.

## DAIRY BUREAU.

Messrs. C. L. Hartshorn of Worcester, Geo. L. Clemence of Southbridge, D. A. Horton of Northampton, *appointed by the Governor.* Secretary Wm. R. Sessions, *Executive Officer.* Geo. M. Whitaker of Boston, *Assistant Executive Officer, appointed by the Governor.*

## SPECIALISTS.

### By Election of the Board.

| | | |
|---|---|---|
| *Chemist*, . . . . . | Dr C. A. Goessmann, . . . . . . | Amherst. |
| *Entomologist*, . . . | Prof. C. H. Fernald, . . . . . . | Amherst. |
| *Botanist and Pomologist*, . | Prof. S. T. Maynard, . . . . . . | Amherst. |
| *Veterinarian*, . . . | Prof. James B. Paige, . . . . . . | Amherst. |
| *Engineer*, . . . . | Wm. Wheeler, . . . . . . . | Concord. |
| *Ornithologist*, . . . | E. H. Forbush, . . . . . . . | Malden. |

### By Appointment of the Secretary.

*Librarian and Curator*, F. H. Fowler, B.Sc., *First Clerk.*

# MASSACHUSETTS AGRICULTURAL COLLEGE.

*Location, Amherst, Hampshire County.*

## Board of Trustees.

| | Term Expires. |
|---|---|
| Elijah W. Wood of West Newton, | 1895 |
| Chas. A. Gleason of New Braintree, | 1895 |
| Daniel Needham of Groton, | 1896 |
| James Draper of Worcester, | 1896 |
| Henry S. Hyde of Springfield, | 1897 |
| Merritt I. Wheeler of Great Barrington, | 1897 |
| James S. Grinnell of Greenfield, | 1898 |
| Joseph A. Harwood of Littleton, | 1898 |
| William H. Bowker of Boston, | 1899 |
| J. D. W. French of North Andover, | 1899 |
| J. Howe Demond of Northampton, | 1900 |
| Elmer D. Howe of Marlborough, | 1900 |
| Francis H. Appleton of Peabody, | 1901 |
| William Wheeler of Concord, | 1901 |

## Members ex Officio.

His Excellency Governor F. T. Greenhalge,
*President of the Corporation.*

| | |
|---|---|
| Henry H. Goodell, M.A., LL.D, | *President of the College.* |
| ——— —— | *Secretary of the Board of Education.* |
| William R. Sessions, | *Secretary of the Board of Agriculture.* |

## Officers Elected by the Board of Trustees.

| | |
|---|---|
| James S. Grinnell of Greenfield, | *Vice-President of the Corporation.* |
| William R. Sessions of Hampden, | *Secretary.* |
| Prof. Geo. F. Mills of Amherst, | *Acting Treasurer.* |
| Charles A Gleason of New Braintree, | *Auditor.* |

## Board of Overseers.

The State Board of Agriculture.

## Examining Committee of the Board of Agriculture.

Messrs. Varnum, Cruickshanks, Harwood, Kimball and Bursley.

## Hatch Experiment Station of the Massachusetts Agricultural College.

| | |
|---|---|
| Henry H. Goodell, M.A., LL.D., | *Director.* |
| William P. Brooks, B Sc., | *Agriculturist.* |
| Samuel T. Maynard, B.Sc., | *Horticulturist.* |
| Charles H. Fernald, Ph.D., | *Entomologist.* |
| Clarence D Warner, B Sc, | *Meteorologist.* |

# MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

*Location, Amherst, Hampshire County.*

## Board of Control.

His Excellency F. T. Greenhalge, Governor of the Commonwealth, *President ex officio.*

| | Term Expires. |
|---|---|
| Wm. H. Bowker of Boston, | 1895 |
| Calvin L. Hartshorn of Worcester, | 1897 |
| Elected by the State Board of Agriculture. | |
| Elmer D. Howe of Marlborough, | 1897 |
| J. Howe Demond of Northampton, | 1896 |
| Elected by the Board of Trustees of the Massachusetts Agricultural College. | |
| Francis H. Appleton of Peabody, | 1894 |
| Elected by the Massachusetts Society for Promoting Agriculture. | |
| Wm. H. Porter of Agawam, | 1895 |
| Elected by the Massachusetts State Grange. | |
| William C. Strong of Newton (P. O. Waban), | 1894 |
| Elected by the Massachusetts Horticultural Society. | |

Henry H. Goodell, M.A., LL.D., of Amherst, *President of the Massachusetts Agricultural College.*

Charles A. Goessmann, Ph.D., LL.D., of Amherst, *Director of the Station.*

William R. Sessions of Hampden, *Secretary of the State Board of Agriculture.*

### Officers Elected by the Board of Control.

Henry H. Goodell, M.A., LL.D , of Amherst, . . . *Vice-President.*

William R. Sessions of Hampden, . . . *Secretary and Auditor.*

Charles A. Goessmann, Ph.D., LL.D., of Amherst, *Director, Chemist and Acting Treasurer.*

## BOARD OF CATTLE COMMISSIONERS.

| | Term Expires. |
|---|---|
| Levi Stockbridge of Amherst, *Chairman*, | 1894 |
| Chas. P. Lyman, F.R.C.V.S., of Boston, *Secretary*, | 1896 |
| Maurice O'Connell, D.V.S., of Holyoke, | 1895 |

## AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

| NAME. | PRESIDENT. | SECRETARY. | TREASURER. |
|---|---|---|---|
| Amesbury and Salisbury,* | C. W. Woods, Newbury | A. H. Fielden, Amesbury. | W. H. Dewhurst. Amesbury. |
| Attleborough (Agric'l Asso.), | S. O. Bigney, Attleborough. | Geo. Randall, Attleborough. | L. F. Mendell, Plainville. |
| Barnstable County, | John Simpkins, Yarmouth. | Fred C. Swift, Yarmouthport. | Albert F. Edson, Barnstable. |
| Berkshire, | Wesley B. Barton, Dalton. | Frank H. Cande, Pittsfield. | J. P. Merrill, Pittsfield. |
| Blackstone Valley, | Wm. J. Taft, Uxbridge. | William L. Johnson, Uxbridge. | F. W. Barnes, Uxbridge. |
| Bristol County, | W. C. Baylies, Taunton. | A. B. Hodges, Taunton. | Franklin Pratt, Taunton. |
| Deerfield Valley, | D. W. Temple, Shelburne Falls. | S. W. Hawkes, Charlemont. | H. N. Warner, Charlemont. |
| Eastern Hampden, | Chas. E. Fuller, Palmer | O. P. Allen, Palmer. | O. P. Allen, Palmer. |
| Essex, | Francis H. Appleton, Lynnfield. | J. M. Danforth, Lynnfield Centre. | G. L. Streeter, Salem. |
| Franklin County, | J. D. Avery, Buckland. | Wm. S. Allen, Greenfield. | Wm. S. Allen, Greenfield |
| Hampden, | Chas. F. Fowler, Westfield. | Wm. H. Porter, Agawam. | E. S. Batchelder, Springfield. |
| Hampshire, | William P. Brooks, Amherst. | J. W. Kellogg, Amherst. | J. W. Kellogg, Amherst. |
| Hampshire, Franklin and Hampden, | E. E. Wood, Northampton. | S. S. Warner, Northampton. | D. J. Wright, Northampton. |
| Highland, | M. J. Smith, Middlefield. | J. McElwain, Middlefield. | M. J Smith, Middlefield. |
| Hillside, | Alvan Barrus, Goshen. | William G. Atkins, West Cummington. | R. R. Packard, Cummington. |
| Hingham,* | E. L. Ripley, Hingham | William H. Thomas, Hingham. | Reuben Sprague, Hingham. |
| Hoosac Valley, | Geo P. Carpenter, Blackinton. | George F. Miller, North Adams. | M. R. Ford, North Adams. |
| Housatonic, | H. L. Rowe, Egremont. | O. C. Bidwell, Great Barrington. | W. B. Sanford, Great Barrington. |
| Marshfield,* | Walton Hall, Marshfield. | Francis Collamore, North Pembroke. | Francis Collamore, North Pembroke. |
| Martha's Vineyard, | H. L. Whiting, West Tisbury. | B. T. Hillman, Edgartown. | Geo H. Luce, West Tisbury |
| Massachusetts Horticultural, | N. T. Kidder, Milton. | Robert Manning, Boston. | C. E. Richardson, Cambridgeport. |
| Middlesex North, | A. C. Varnum, Lowell. | Geo. B. Coburn, Lowell. | S. Drewett, Lowell. |
| Middlesex South, | Isaac Damon, Cochituate. | Edgar Potter, South Framingham. | C. J. Frost, Framingham. |
| Nantucket, | J. S. Appleton, Jr., Nantucket. | J. F. Murphey, Nantucket | Asa C. Jones, Nantucket. |
| Oxford, | D. M. Howe, Charlton. | W. H. H. Thurston, Oxford. | W. H. H. Thurston, Oxford. |
| Plymouth County, | A. Pratt, North Middleborough. | George M. Hooper, Bridgewater. | Cyrus A. Lewis, Bridgewater. |
| Spencer (Farmers' and Mechanics' Association), | C. N. Prouty, Spencer. | F. B. Watson, Spencer. | A. W. Curtis, Spencer. |

* And horticultural.

## AGRICULTURAL SOCIETIES, ETC. — *Continued.*

| NAME. | PRESIDENT. | SECRETARY. | TREASURER. |
|---|---|---|---|
| Union,* | J. J. Lloyd, Blandford. | E. W. Boise, Blandford. | W. J. Peebles, Blandford. |
| Weymouth (Ag'l and Ind.), | B. F. Poole, Rockland. | H. Wilbur Dyer, South Weymouth. | Gordon Willis, South Weymouth. |
| Worcester, | L. F. Herrick, Millbury. | John B. Bowker, Worcester. | John B. Bowker, Worcester. |
| Worcester East, | John E. Thayer, Lancaster. | W. A. Kilbourn, South Lancaster. | Lucius Field, Clinton. |
| Worcester North, | Geo. B. Andrews, Fitchburg. | John W. Ogden, Fitchburg. | N. C. Upham, Fitchburg. |
| Worcester North-west (Ag'l and Mechanical), | W. H. Lee, New Haven, Ct. | Arthur F. Tyler, Athol. | T H. Goodspeed, Athol Centre. |
| Worcester South, | Thos. H. Jones, Warren. | C. V. Corey, Sturbridge. | C. V. Corey, Sturbridge. |
| Worcester County West, | Horatio Moore, New Braintree. | Matthew Walker, Barre. | Charles H. Follansby, Barre. |

* And horticultural.

## HORTICULTURAL SOCIETIES.

| NAME. | LOCATION. | PRESIDENT. | SECRETARY. |
|---|---|---|---|
| Hampden County, | Springfield, | J E. Taylor, Springfield. | B. L. Bragg, Springfield. |
| Houghton, | Lynn, | J. W. Goodell, M.D., Lynn. | Frank W. Mace, Lynn. |
| Hyde Park, | Hyde Park, | H. J. Stockford, Hyde Park. | J. R. Andrews, Hyde Park. |
| Massachusetts,* | Boston, | N. T. Kidder, Milton. | Robert Manning, Boston. |
| Newton, | Newton, | D. D Slade, Chestnut Hill. | L H. Farlow, Newton. |
| Springfield Amateur, | Springfield, | Joseph Aumer, Springfield. | George H. Lapham, Springfield. |
| Wakefield,† | Wakefield, | Edwin C. Miller, Wakefield. | Mrs J F. Woodward, Wakefield. |
| Worcester County, | Worcester, | H. L. Parker, Worcester. | E. W. Lincoln, Worcester. |

* Incorporated and represented on the Board of Agriculture.

† And agricultural.

## FARMERS' AND MECHANICS' ASSOCIATIONS.

| | | | |
|---|---|---|---|
| Bolton, | Bolton, | H. F Haynes, Bolton. | Geo. H. Brigham, Bolton. |
| Leominster, | Leominster, | A. L. Whitney, Leominster. | C. H. Rice, Leominster. |
| Middlesex and Worcester, | Hudson, | Francis Howe, Hudson | Josiah S. Welsh, Hudson. |
| Needham, | Needham, | Chas F. Smith, Needham. | A. K. Tisdale, Dover. |
| Oakham, | Oakham, | H. P. Austin, Oakham | William S. Crawford, Oakham. |
| Princeton, | Princeton, | J. C. F Mirick, Princeton. | J. E. Merriam, Princeton. |

## FARMERS' AND MECHANICS' CLUBS.

| | | | |
|---|---|---|---|
| Ashby, | Ashby, | H. R. Foster, Ashby. | C. S. Blake, Ashby. |
| Belchertown, | Belchertown, | G. L. Kent, Belchertown. | J. J Overing, Belchertown. |
| Berlin, | Berlin, | P. B. Southwick, Berlin Centre. | J. D. Southwick, Berlin Centre. |
| Groton, | Groton, | Daniel Needham, Groton. | Charles Woolley, Groton. |
| Holden, | Holden, | G. S. Holden, Holden. | Franklin Moore, Holden. |
| Pepperell, | Pepperell, | A. S. Shattuck, Pepperell. | S. R. Merrill, Pepperell. |
| Shirley, | Shirley, | E. G. Adams, Shirley. | – – – |
| Shrewsbury, | Shrewsbury, | E. A Bartlett, Shrewsbury. | F. J. Stone, Shrewsbury. |
| West Acton, | West Acton, | Isaac Reed, West Acton. | C. B. Stone, West Acton. |
| Wilmington, | Wilmington, | H. Allen Sheldon, Wilmington. | E. M. Nichols, Wilmington. |

## FARMERS' CLUBS.

| | | | |
|---|---|---|---|
| Ashfield, | Ashfield, | John M. Sears, Ashfield. | F. G Howes, Ashfield. |
| Boxborough, | Boxborough, | E. B. Cobleigh, West Acton. | J. F. Hayward, West Littleton. |
| Buckland, | Buckland, | E. C. Maynard, Buckland. | F. Forbes, Buckland. |
| Chamberlain District, | Worcester, | B. W. Potter, Worcester. | S. A. Burgess, Worcester. |
| East Charlemont, | East Charlemont, | Reuben Streeter, East Charlemont. | J. G. Johnson, East Charlemont. |
| Easthampton, | Easthampton, | L. E. Parsons, Easthampton. | George H. Parsons, Easthampton. |
| Franklin, | Franklin, | C. M. Allen, Franklin. | L. W. Daniels, Franklin. |
| Halifax, | Halifax, | Otis Pratt, Halifax. | Mrs. J. S. Pope, Halifax. |

## FARMERS' CLUBS — *Continued.*

| NAME. | LOCATION. | PRESIDENT. | SECRETARY. |
|---|---|---|---|
| Huntington, | Huntington, | C. H. Strong, Norwich. | H. W. Stickney, Norwich. |
| Lancaster, | Lancaster, | George W. Morse, South Lancaster. | F A Hanaford, South Lancaster. |
| Lunenburg, | Lunenburg, | C. E. Cox, Lunenburg. | James Hildreth, 2d, Lunenburg. |
| Marblehead and Swampscott, | Beach Bluff, | William Miller, Swampscott. | – – – |
| New Braintree, | New Braintree, | D. C. Wetherell, New Braintree. | E. W. Barr, New Braintree. |
| New Salem, | New Salem, | D. F. Carpenter, Millington. | Willard Putnam, Cooleyville. |
| North Raynham, | North Raynham, | – – – | N. W. Shaw, North Raynham. |
| North Westport, | North Westport, | E. L. Gifford, North Westport. | A. S. Sherman, North Westport. |
| Practical, | Egremont, | Theodore Baldwin, North Egremont. | Mrs. H. T. Candee, Sheffield. |
| Rehoboth, | Rehoboth, | S A. Cash, Central Falls, R. I. | A. M. Bliss, Pawtucket, R. I. |
| Rowley, | Rowley, | J. D. Dodge, Rowley. | T. P. Hale, Rowley. |
| Royalston, | Royalston, | A D. Raymond, Royalston. | G. E. Pierce, Royalston |
| Rutland, | Rutland, | Ira G. Dudley, West Rutland. | Mrs. J. W. Munroe, Rutland. |
| Southborough, | Southborough, | Wm. H. Buck, Southborough. | D. W. C. McMasters, Southborough. |
| South Bristol, | New Bedford, | Franklyn Howland, Acushnet. | Geo. A. Potter, New Bedford |
| South Deerfield, | South Deerfield, | E. W. Jackson, South Deerfield. | W. W Sanderson, South Deerfield. |
| Sterling, | Sterling, | L. W Rugg, Sterling. | A. H. Sawyer, Sterling |
| Tatnuck, | Worcester, | F. J. Kinney, Worcester. | Elliot Moore, Worcester. |
| Upton, | Upton, | G. H. Stoddard, Upton. | Robert A. Pierce, Upton. |
| Waltham, | Waltham, | M R. Leonard, Waltham. | A Starbuck, Waltham. |
| West Bridgewater, | West Bridgewater, | F. E. Howard, West Bridgewater. | Mrs. H. J LeLacheur, W. Bridgewater. |
| West Brookfield, | West Brookfield, | S. N. Cutler, Warren. | L. H Chamberlain, West Brookfield. |
| West Newbury, | West Newbury, | L H Bailey, West Newbury. | I. N. Lane, West Newbury. |
| West Peabody, | West Peabody, | Mrs F C. Durkee, West Peabody. | Bertha G. Small, West Peabody. |
| Wilbraham, | Wilbraham, | B. F. Green, Wilbraham. | H. M. Bliss, Wilbraham. |

### MISCELLANEOUS.

| NAME. | LOCATION. | PRESIDENT. | SECRETARY. |
|---|---|---|---|
| Agricultural Library Association, | Swansea, | E. M. Thurston, South Swansea. | A. E. Arnold, Swansea Centre. |
| Boston Market Gardeners' Association, | Boston and vicinity, | W. W. Rawson, Arlington. | C A. Learned, Arlington. |
| Bristol Co. Fruit Growers' Association, | Dighton, | Chas. N. Simmons, Dighton. | W. P. Eddy, Dighton. |

| | | | |
|---|---|---|---|
| Brockton Agricultural Society,* | Brockton, | H. W. Robinson, Boston. | Ira Copeland, Brockton. |
| Burlington Agricultural Society, | Burlington, | T I Reed, Burlington. | H. H. Nichols, Burlington. |
| Cranberry Growers' Association, | Cape Cod District, | J J. Russell, Plymouth | I T. Jones, Sandwich. |
| Farmers' and Gardeners' Club, | Hanson, | George F. Simpson, Hanson. | F. S. Thomas, M D , Hanson. |
| Franklin Harvest Club, | Connecticut Valley, | C. E. Williams, South Deerfield. | C. B. Lyman, Southampton. |
| Hampden Harvest Club, | Connecticut Valley, | The members alternately. | J. N. Bagg, West Springfield. |
| Westborough Agricultural Society,* | Westborough, | Wm. Graham, Westborough. | Wm. M. Ferguson, Westborough. |
| Young Men's Harvest Club, | Ludlow, | H. E. Miller, Ludlow. | E. N. Fisher, Ludlow. |
| Young People's Agricultural Club, | Wilbraham, | Lee W. Rice, Wilbraham. | Walter M. Bliss, Wilbraham. |

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* Incorporated under general laws.

# MASSACHUSETTS PATRONS OF HUSBANDRY.

## OFFICERS OF THE STATE GRANGE, 1894.

| | |
|---|---|
| Master, | E. D. Howe of Marlborough. |
| Overseer, | A. C. Stoddard of North Brookfield |
| Lecturer, | J. W. Stockwell of Sutton. |
| Steward, | E. A. Emerson of Haverhill. |
| Assistant Steward, | W. N. Howard of South Easton. |
| Chaplain, | Rev. C. S. Walker of Amherst. |
| Treasurer, | F. A Harrington of Worcester. |
| Secretary, | W. C. Jewett of Worcester. |
| Gate Keeper, | C. H. Deming of Lanesborough. |
| Pomona, | Mrs. E. Cushman of Lakeville. |
| Flora, | Lizzie I. Huntington of Amesbury. |
| Ceres, | Mrs. Emma Eaton of Fitchburg. |
| Lady Assistant Steward, | Mrs. Jennie F. Williams of East Douglas. |

## EXECUTIVE COMMITTEE.

| | |
|---|---|
| H. A. Barton, Jr., of Dalton, | One year. |
| C. A. Dennen of Pepperell, | Two years. |
| Geo. L. Clemence of Southbridge, | Three years. |

## DEPUTIES.

| | |
|---|---|
| J. B Parkin, | Holliston. |
| Geo. B. Bradley, | Methuen. |
| H. A. Wheeler, | Berlin. |
| Mrs. Minnie M. Chase, | Medfield. |
| Mrs. Mary L. Kinsman, | Ipswich. |
| Wesley B. Barton, | Dalton. |
| George A. Hastings, | Boylston Centre. |
| James Hildreth, 2d, | Lunenburg. |
| Marcellus Boynton, | Central Village. |
| Wm. N. Howard, | South Easton. |
| Geo. L. Ladd, | Sturbridge. |
| Thos. R. Callender, | Northfield. |
| F. H. Stevens, | West Acton. |
| Wm. H. Porter, | Agawam. |

## MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|---|---|---|---|
| *Pomona Granges.* | | | |
| Middlesex and Norfolk, No. 1, | N. H Fales, Pondville | Abel F. Stevens, Wellesley. | Mrs. N. H. Fales, Pondville. |
| Essex County, No. 2, | Peter Holt, Jr., North Andover. | Stephen K. Fowler, West Boxford. | J. Warren Moore, Andover. |
| Middlesex and Worcester, No 3, | Alonzo Eaton, Fitchburg. | Mrs. M. E. Manning, Townsend. | Miss Annie E. Robbins, Lowell. |
| Franklin and Worcester, No. 4, | M. H. Jerome, Orange. | Dora M Rice, North Orange. | Flora J. Butterworth, Athol. |
| Worcester West, No. 5, | B. W. Spooner, Petersham. | E. A. Albee, North Dana | D. Parsons, Hubbardston. |
| Berkshire County, No. 6, | C. H. Deming, Lanesborough. | Frank A. Palmer, Stockbridge. | M. Agnes Young, Dalton. |
| *District Granges.* | | | |
| Lancaster, | Geo. A. Hastings, Boylston. | W. A Kilbourn, South Lancaster. | Mrs. E. T. Cunningham, Lancaster. |
| Worcester Central County, | Henry W. Carter, Millbury. | Mrs. Jennie F. Williams, East Douglas. | John B. Bowker, Worcester. |
| Borough District, | F. H. Stevens, West Acton. | W. V. Thompson, Woodville. | Mrs. Addison Keyes, Berlin. |
| Worcester Southwest, | H W. Nichols, Sturbridge. | Mrs. Mary E. Lakin, Brookfield. | Miss Mary E Fairbanks, W. Brookfield. |
| Springfield, | F G. Bennett, Ludlow | W S. Clark, Granby. | Miss Carrie S. Leonard, Agawam. |
| Mendon, | Dr. Nathan Sanborn, Bellingham. | Clara Thayer, Blackstone. | Carrie E. Daniels, Blackstone |
| Connecticut Valley, | Herbert Sabin, East Amherst. | Howard C. West, Belchertown. | Miss Sarah E. Mason, Northampton. |
| Old Colony, | Marcellus Boynton, Central Village. | Elbridge Cushman, Middleborough. | Miss Alida H. Rogers, Holbrook. |
| *Subordinate Granges.* | | | |
| Northfield, No. 3, | T. R. Callender, Northfield. | L. R. Smith, East Northfield. | Miss Mabel Lyman, East Northfield. |
| Groton, No. 7, | F. M. Boutwell, Groton. | Daniel Needham, Groton. | Miss Bessie E. Adams, Groton. |
| Barre, No. 9, | A. P. Clark, Barre. | Mrs. M. N. Stone, Barre. | M. John Hancock, Jr., Barre. |
| Amherst, No. 16, | Herbert Sabin, East Amherst. | H. M. Thompson, Amherst. | C. E. Wakefield, Amherst. |
| Hinsdale, No. 19, | Thos. F. Barker, Hinsdale. | Mrs. F. F. Watkins, Hinsdale. | John S. Cole, Hinsdale. |
| Lanesborough, No. 21, | S. L. Miner, Lanesborough. | W. S. Boyce, Lanesborough | C. H. Deming, Lanesborough. |
| Worcester, No. 22, | Joseph E. Goodell, West Boylston. | Miss Effie Draper, Worcester. | Miss Ellen M Flagg, Worcester. |
| Dalton, No. 23, | Mrs. S. I. Parker, Dalton | H. L. Allen, Dalton. | M. Agnes Young, Dalton. |
| Sterling, No 53, | Edwin H. Coolidge, Sterling. | Mrs. Lilla Truell, Clinton. | Agnes S. Kilburn, Sterling. |
| Auburn, No 60, | H. J. Marcy, Auburn. | Mrs. W. H. Stockwell, West Millbury. | J. H. Prouty, Auburn. |
| "Union" of Belchertown, No 64, | H C. West, Belchertown. | G. L. Kent, Belchertown. | Mrs. M J. Ward, Belchertown. |
| Hardwick, No 67, | W A. Newcomb, Hardwick. | Mrs. W. A. Newcomb, Hardwick. | Susie B. Manly, Hardwick. |
| "Prescott" of Pepperell, No. 73, | John O. Bennett, Pepperell. | A. N. Blood, Pepperell. | Edmund S. Blood, Pepperell. |

## MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|---|---|---|---|
| Paxton, No. 75, | Ledyard Bill, Paxton. | Oliver Goodnow, Paxton. | Mrs. S. E. Glidden, Paxton. |
| Holden, No. 78, | Mrs. G. S. Graham, Holden. | Chas. B. Jordan, Holden. | Mrs. S. N. Hubbard, Holden. |
| Spencer, No. 79, | Edson C. Bemis, Spencer. | Joseph H. Blanchard, Spencer. | Mrs. Edson C. Bemis, Spencer. |
| "Manhan" of Southampton, No. 82, | Homer O. Strong, Southampton. | Mrs. C. P. Gridley, Southampton. | Mrs Geo K. Edwards, Southampton. |
| North Orange, No. 86, | M. L. Gerhard, Tully. | A. C. Wakefield, Tully. | Ellen S. Prentice, Tully. |
| Lee, No. 88, | Jas. Seacord, Lenox. | C. H. Shaylor, Lee. | C. O. Swift, Lee. |
| Charlton, No. 92, | H. M. Dodge, Charlton. | Mrs. Charlotte A. Bacon, Charlton. | Fannie E. Burlingame, Charlton. |
| Grafton, No. 93, | Silas E. Stowe, Grafton. | Mrs. L. M. Rice, North Grafton. | Miss Eva B. Banister, Grafton. |
| Petersham, No. 95, | H. H. Lindsey, Petersham. | R. J. Stone, Petersham. | M. E. Prouty, Petersham. |
| Shrewsbury, No. 101, | E. A. Bartlett, Shrewsbury. | Mrs. Curtis Jenkins, Shrewsbury. | Mrs. A. S. Rice, Shrewsbury. |
| Stow, No. 103, | Francis H. Stevens, West Acton. | Mrs. Francis H. Stevens, West Acton. | Mrs. U. M. Lewis, Stow. |
| "Garfield" of North Dana, No. 104, | E. A. Albee, North Dana | Mrs. Martha Childs, North Dana. | Mrs. Mary Doubleday, North Dana. |
| Marlborough, No. 105, | E. N. Stratton, Marlborough. | C. S. Howe, Marlborough. | Mrs. Abbie A. Nichols, Marlborough. |
| West Boylston, No. 106, | Edwin O. Tyler, West Boylston. | Miss Mabel S. Broad, West Boylston. | Mrs. A D. Lord, West Boylston. |
| Millbury, No. 107, | E. A. Waters, Millbury. | I. E. Howe, Millbury. | Miss Emma A. Doescher, Millbury. |
| Hudson, No. 108, | W. R. Coolidge, Hudson. | Miss Nellie G. Ketchum, Hudson. | Mary E. Hall, Hudson. |
| Sutton, No. 109, | C. N. Woodbury, Sutton. | Dr. E. M. Welsh, Sutton. | Miss S. M. Mills, Sutton. |
| Sherborn, No. 110, | G. L Whitney, South Framingham. | N. B. Douglas, Sherborn. | Miss A. L. Bickford, Sherborn. |
| Boylston, No. 111, | Calvin H. Hastings, Clinton. | Chas. C. Bray, Boylston. | Mrs. Nellie M. Prouty, Boylston Centre. |
| "East Medway" of Millis, No. 112, | Geo. C Thrasher, Millis | Everett D. Hooper, M.D., Millis. | Aug. L. Ware, Millis. |
| Framingham, No. 113, | Harry B. Walkup, Framingham. | Mrs. Luther Marston, Framingham. | Miss Vina Walkup, Framingham. |
| Medfield, No 114, | Tobias E. Steere, Medfield. | J. H. Baker, Medfield. | Mrs. W. W. Preston, Medfield. |
| Holliston, No. 115, | H. N. Rogers, Holliston. | Mrs. H. N. Rogers, Holliston. | Fannie J Hayes, Holliston. |
| Westborough, No. 116, | James Martin, Westborough. | Mrs. Mary C. Graham, Westborough. | Jennie W. Graham, Westborough. |
| Dover, No. 117, | Thomas McGill, Dover. | Mrs. S. M. Colcord, Dover. | Jennie W. McGill, South Natick. |
| Southborough, No. 118, | Waldo A. Fay, Southborough. | Mrs. Chas. Temple, Southborough. | Chas. W. Jenison, Southborough. |
| Northborough, No. 119, | M. M. Thompson, Northborough. | O. E. Eldridge, Northborough. | M. S. Wood, Northborough. |
| Lancaster, No. 120, | E. T. Cunningham, Lancaster. | Mrs. E. T. Cunningham, Lancaster. | Ella C. Divol, Lancaster. |
| Sudbury, No. 121, | L. W. Gilbert, Sudbury. | Henry N. Smith, South Sudbury. | Geo. H. Thompson, Sudbury. |

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|---|---|---|---|
| Templeton, No 122, | Prescott F. French, Templeton. | Lucien Gove, East Templeton. | Thos. B. Clark, Baldwinville. |
| Oxford, No. 123, | Geo. S Eddy, Oxford. | Franklin H. Clark, Oxford. | Walter A. Lovett, Oxford. |
| Ashland, No. 124, | Henry C. Burnham, Ashland. | A. R. Stevens, Ashland. | Fannie Pratt, Ashland. |
| Upton, No. 125, | A. W. Emerson, West Upton. | A. H. Chapman, West Upton. | Mrs. L. J. Chapman, West Upton. |
| Hubbardston, No. 126, | J. Frank Flagg, Hubbardston. | Mrs. Annie Leach, Hubbardston. | J. Harry Allen, Hubbardston. |
| Amesbury, No. 127, | J A. Davis, Amesbury. | Mrs. Geo. B. Palmer, So.Hampton, N. H | Miss Nellie A. Huntington, Amesbury. |
| North Andover, No. 128, | Edward A. Fuller, North Andover. | Mary E. Nason, West Boxford. | Lizzie F. Ingalls, North Andover. |
| Gardner, No 130, | B. B. Goodale, Gardner | H. L. Smith, Gardner. | Mrs. Mary A. Stone, Gardner. |
| Boxborough, No. 131, | D. W. Cobleigh, West Littleton. | Mrs. Jennie A. Littlefield, West Acton. | Miss Mabel L. Dodge, West Acton. |
| North Brookfield, No. 132, | Dudley C. Perkins, No. Brookfield. | John P. Ranger, North Brookfield. | Lizzie A. Doescher, North Brookfield. |
| West Dedham, No. 133, | Lucius Damrell, West Dedham. | Addie L. Gay, West Dedham | Annie L. Richardson, West Dedham. |
| Berlin, No. 134, | H. A. Wheeler, Berlin. | Lilla B. Newsome, South Berlin. | Mrs. H. J. Brewer, Berlin. |
| Norfolk, No. 135, | H. Lyman Towne, City Mills. | Siles E. Fales, Norfolk. | Maybelle N. Drayton, Norfolk. |
| Ipswich, No. 136, | Mary L. Kinsman, Ipswich | N. R. Underhill, Ipswich. | Frank A. Stackpole, Ipswich. |
| East Blackstone, No. 137, | Adrian Scott, East Blackstone. | Mrs. Addie M. Stearns, East Blackstone | Mrs. N. A. Thayer, East Blackstone. |
| Northampton, No. 138, | John McQuestion, Hadley. | Allen Strong, Northampton. | Miss Sarah E. Mason, Northampton. |
| East Sandwich, No. 139, | Jerome K. Holway, East Sandwich. | John F. Carlton, East Sandwich. | Helen F. Holway, East Sandwich. |
| West Boxford, No. 140, | John T. Chadwick, West Boxford. | Wm. K. Cole, West Boxford. | Matilda B. Lund, West Boxford. |
| Montague, No 141, | Chas. M. Hemminway, No. Leverett | Mrs. Mary J. Marsh, Montague. | G. H. Goddard, Montague. |
| Bolton, No. 142, | Wm N. Felton, Bolton. | Mrs. Geo. L. Taylor, Bolton. | Mrs. C. S. Walcott, Bolton. |
| Mendon, No. 143, | Moses U. Gaskill, Mendon. | Dora Davenport, Mendon. | Albert W. Gaskill, Mendon. |
| Franklin, No. 144, | J. L. Fisher, City Mills. | Mrs. J. L. Fisher, City Mills, | R. M. Handy, Franklin. |
| Douglas, No. 145, | J. A. Williams, East Douglas. | Mary A. Richardson, Douglas. | T. Marshall Potter, Douglas. |
| West Newbury, No. 146, | L. W. Bradley, West Newbury. | Mrs. L. M. Newell, West Newbury. | Miss Jennie P. Carlton, West Newbury. |
| West Springfield, No. 147, | A. A. Sibley, West Springfield. | N. T. Smith, West Springfield. | E. T. Sikes, West Springfield. |
| Swansea, No. 148, | Nathan M. Wood, Swansea Centre. | Mrs. Wm. Coggeshall, Warren, R. I. | Etta L. Gardner, Swansea Centre. |
| Harvard, No. 149, | H. D. Stone, Still River. | Mrs. H. D. Stone, Still River. | I. P. Baker, Harvard. |
| Concord, No. 150, | O. E. Patch, Concord. | Mrs. E. L. Tuttle, Concord. | George Buttrick, Concord. |
| Agawam, No. 151, | John Oldroyd, Agawam. | Geo. H. Reed, Agawam. | Carrie S. Leonard, Agawam. |
| East Longmeadow, No. 152, | M. B. Sikes, Springfield. | E. M. Burt, East Longmeadow. | F. H. Whitaker, East Longmeadow. |
| Wilbraham, No. 153, | Frank A. Gurney, Wilbraham. | Miss G. J. Wetherbee, Wilbraham. | Mrs. W. L. Phelps, Wilbraham. |
| Haverhill, No. 154, | F. O. Wheeler, Salem, N. H. | Frank J. Cunningham, Haverhill. | Isaiah J. Webster, Haverhill. |
| Methuen, No. 155, | Geo. C. Snell, Lawrence. | Helen C. Bradley, Lawrence. | Mrs. Mary A. Crosby, Methuen. |
| West Bridgewater, No. 156, | H. Eugene Weston, Westdale. | Mrs. Martha K. Crosby, Matfield. | Chas. R. Packard, West Bridgewater. |
| Granby, No. 157, | W. S. Clark, Granby. | Mrs. W. S. Clark, Granby. | Mrs. A. J. Whitmarsh, Granby. |

## MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|---|---|---|---|
| "Nemasket" of Middleborough, No. 158, | Mrs. E. Cushman, Lakeville. | Amos H. Eaton, Middleborough. | Chester E. Weston, Middleborough. |
| "Green River" of Williamstown, No. 159, | S. A. Hickox, So. Williamstown. | J. M. Stevens, Williamstown. | M. E. Evans, Williamstown. |
| South Hadley, No. 160, | Irving N. Day, South Hadley. | H. E. Brainard, South Hadley. | Mrs. I. N. Day, South Hadley. |
| "Laurel" of West Newbury, No. 161, | F. H. Poore, Newburyport. | C. E. Rowell, West Newbury. | F. B. Prescott, West Newbury. |
| Dartmouth, No. 162, | M. Frank Nicholson, Dartmouth. | H. M. Plummer, Dartmouth. | Geo. T. Nicholson, Dartmouth. |
| Dudley, No 163, | Monroe W. Ide, Dudley. | Mrs. Clara M. Arnold, Dudley. | Gilbert F. Pratt, Dudley. |
| Ware, No. 164, | J. H. Fletcher, Ware. | E. W. Barney, Ware. | F. H. Doane, Ware. |
| Hampden, No. 165, | Dr. Geo. T. Ballard, Hampden. | Elizabeth Beebe, Hampden. | Mrs. A. J. Tuttle, Hampden. |
| Wellesley, No. 166, | Abel F. Stevens, Wellesley. | Geo. L. Chesbro, Wellesley. | Ella C. Lyon, Wellesley. |
| Somerset, No. 168, | Wm. H. Chase, Pottersville. | Joseph Gibbs, Pottersville. | Albert Marble, Pottersville. |
| Lunenburg, No. 169, | John Wooldredge, Lunenburg. | Hattie D. Stone, Lunenburg. | Jas. Hildreth, Lunenburg. |
| New Braintree, No. 170, | J. D. Frost, New Braintree. | Horatio Moore, New Braintree. | Mrs. M. E. Moore, New Braintree. |
| Merrimac, No 171, | John H. Noyes, Plaistow, N. H. | Mrs. Maggie Wallice, Merrimac. | Miss Alice J. Hoyt, Merrimac. |
| Ashby, No. 172, | Chas C. Damon, Ashby. | Albert I. Hayward, Ashby. | S. L. Parker, Ashby. |
| Hopkinton, No. 173, | Elijah Fitch, Hopkinton. | Mrs. F. H. Low, Hopkinton. | Arthur Fitch, Hopkinton. |
| Brookfield, No. 174, | Walter B. Mellen, Brookfield. | Annie G. Laflin, Brookfield. | Andrew A. Brigham, Brookfield. |
| Athol, No. 175, | W. H. Frost, Athol Centre. | Ella Southlund, Athol Centre. | Mrs. Matilda J. Tooley, Athol. |
| "Miller's River" of Orange, No. 176, | D. L. Crandall, Orange. | Mrs. M. A. Jerome, Orange. | Miss Abbie Lunt, Orange. |
| Sturbridge, No. 177, | G. S Ladd, Sturbridge. | A. E. Shepard, Sturbridge. | Mrs. C. E. Ainsworth, Sturbridge. |
| Monson, No. 178, | Omar Pease, Monson. | F. D. Rogers, Monson. | F. Q. Ball, Monson. |
| Ludlow, No. 179, | F. O. Taylor, Ludlow. | Albert Bennett, Ludlow. | Miss Grace Bennett, Ludlow. |
| West Brookfield, No. 180, | C. S. Johnson, West Brookfield. | Miss Kate Banister, West Brookfield. | Mrs. J. C. Preston, West Brookfield. |
| Westport. No. 181, | Marcellus Boynton, Central Village. | Grace D. Tripp, Westport. | Alvin G Weeks, Central Village. |
| Southbridge, No 182, | Albert E. Weld, Southbridge. | U. A. Goodell, Southbridge. | Wm C. Cady, Southbridge. |
| Andover No 183, | James J. Abbott, Andover | J. Warren Moore, Andover. | Angie M Burtt, Andover. |
| Topsfield, No. 184, | George F. Averill, Topsfield. | Gertrude Bradstreet, Topsfield. | Lillie Donaldson, Topsfield. |
| Fitchburg, No. 186, | Geo. B. Andrews, Fitchburg. | Geo. H. Hastings, Fitchburg. | Jennie M. Hills, Fitchburg. |
| "Satuit" of Scituate, No. 187, | Caleb L. Damon, Scituate Centre. | Mrs. Geo. Cushing, Norwell. | Chas. O. Ellms, Greenbush. |

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| Littleton, No. 188, . . . | Chas. F. Watts, Littleton Common. | Mrs. Chas. F. Watts, Littleton Common. | Miss Susie F. Wing, Littleton. |
| Warren, No 189, . . . | S. N. Cutler, Warren. | Madison Weaver, Warren. | Mrs. G. S. Bridges, Warren. |
| Bellingham, No. 190, . . . | Dr. N. W. Sanborn, Bellingham. | Miss H. A. Billings, Bellingham. | John J. O'Sullivan, Bellingham. |
| Chestnut Hill, No. 191, . . | Everett E. Southwick, Mendon. | Mrs. Annie L. Cheney, Millville. | Olive M. Aldrich, Millville. |
| Winchendon, No. 192, . . | John Gregory, Winchendon | W. H. Sawyer, Winchendon | A. C. Streeter, Winchendon. |
| Foxborough, No 193, . . | Edwin Moultrop, Foxborough. | James W. Alden, Foxborough. | Aurelia L. Buck, Foxborough. |
| Townsend, No. 194, . . . | T. E. Flarity, Townsend. | Eugene R. Kilbourne, Townsend. | Miss M. E. Manning, Townsend. |
| Royalston, No 195, . . . | L. H. Woodbury, Royalston. | Stella V. Newton Royalston. | Carrie W. Raymond, Royalston. |
| Easton, No. 196, . . . | Wm. N. Howard, South Easton. | Wm Robinson, North Easton. | Mrs. W. B. Drew, North Easton. |
| "Brookville" of Holbrook, No. 197, . . . . . . | T. H. West, Holbrook. | W. E. Beal, Brockton. | Mrs. C. H. Buzzell, Holbrook. |
| Leominster, No. 198, . . . | C. H. Currier, North Leominster. | W. J. Nutting, North Leominster. | F. K. Page, Leominster. |
| Stoughton, No 199, . . . | H. F. Maxwell, East Sharon. | Mrs. I. H. Lamb, Stoughton. | Aaron Gay, Stoughton. |
| Uxbridge, No 200, . . . | John E. Hollis, Uxbridge. | Mrs. Wm. Thorn, Uxbridge. | Chas. B. Davis, Millville. |
| Bridgewater, No. 201, . . | H. F. Worrall, Bridgewater. | Mrs. W. M. Black, Bridgewater. | William M. Black, Bridgewater. |

# REPORT.

The following report has been transmitted to the secretary of the State Board of Agriculture, with the request that it be included in the "Agriculture of Massachusetts."

## Report of the National Farmers' Congress at Savannah, Ga., Dec. 12–14, 1893.

*To His Excellency William E. Russell.*

Having been appointed by your Excellency delegate-at-large to represent the Commonwealth of Massachusetts at the thirteenth annual session of the Farmers' National Congress, to be held at Savannah, Georgia, December 12, 13 and 14, 1893, I have the honor to report that I attended the Congress, and took such active part in the same as was especially assigned me by its officers, and noted its proceedings with great care and interest.

The Farmers' National Congress is a voluntary organization and has held its annual sessions in the Western, Southern and Central States. The members of the Congress receive honorary appointment through the courtesy of the governors of the several States.

Subjects for consideration are designated by an executive board, which are assigned in the same manner to prominent members for consideration and discussion. At times full representation has been secured from nearly every State.

At the Congress held at Savannah twenty-four States were represented, and the addresses and other exercises and entertainments connected therewith were of more than ordinary interest.

The city of Savannah is undoubtedly among the most flourishing cities of the South, if not absolutely the leading city in commercial and other business enterprises. Within the last twenty years so vigorous a revival has it had of all that appertains to the industries incident to and growing out of our American civilization that it may be said truly to have entirely outgrown the Savannah of former years. With its magnificent location on the Savannah River, which, by the liberality of the general government, has been deepened and widened, which work of improvement is still going on to radical results, there will be secured for the city not only one of the best harbors of the country, but as safe and easy an approach as any port on the south Atlantic coast. In the exportation of cotton Savannah takes high rank, and in naval stores occupies the leading position among the ports of the world.

The Congress opened its session in the hall of the Savannah Volunteer Guards at 10 o'clock in the forenoon of December 12. Upon the roll-call twenty-four States responded by delegates. First Vice-President D. G. Purse of Georgia presided in the absence of A. W. Smith of Kansas, president of the Congress. After the opening prayer by the Rev. Charles H. Strong, Maj. P. W. Meldrim of Georgia, for and in behalf of Governor Northen, delivered an address of welcome, which was received with marked demonstrations of approval by the delegates. The response was made by Judge Rounse of Maine, who spoke in most complimentary terms of the early history of Georgia. The Congress was then addressed by Hon. J. C. Wade, president of the Georgia Agricultural Society, who gave a warm and generous welcome to the delegates, "many of whom," he said, "had come from one to two thousand miles to take part in the deliberations of the Congress."

It was my fortune to be called upon by the acting president to respond for the Congress. Having alluded to the deep interest which Massachusetts had always taken in public school instruction, and in agriculture as a fundamental industry, I outlined the development of agricultural industries on the part of the general government, covering in brief a period of nearly half a century, and showing that this interest on the part of the nation took deep root in connection with the Patent Office Department, until finally it established a department of its own, having a member of the Cabinet as Secretary of Agriculture, who took equal rank with other recognized members of the Presidential Cabinet; that this national influence had stimulated State and other local interests in every part of the Union. I concluded my address in the following words: "The great underlying principle of agriculture is knowledge, and to maintain and develop that, America depends upon its public schools. Civilization demands universal education, and the growth of civilization is hastened and maintained by the individuality of our people."

His Honor Mayor McDonough gave an address in behalf of the city, in which it appeared that elaborate preparations had been made by the city of Savannah and all the organized bodies of the city, in their art, humane, philanthropic and educational capacities, securing an opportunity for the visitors to see and learn of the present and future outlook of this enterprising metropolis.

It was my privilege to deliver the first advertised address, which related to "Interstate dependence of business relations." Beginning with the Indian trail and following the common roads of New England from the cart-path stage to turnpikes, from turnpikes to canals, from canals to railroads, I undertook to establish that in proportion to the convenience and facility of locomotion and transportation had humanity developed in its commercial, educational and mercantile relations.

Gentlemen from Mississippi, Illinois, Pennsylvania, Florida, Iowa, Kansas, and other States more or less distant delivered addresses upon the importance of constructing State and national highways, establishing communication for vessels of large tonnage from the Great Lakes to the Gulf of Mexico, and the connection of the general government to the State in matters involving schools and colleges for scientific culture.

One entire day was given to a trip to the Atlantic Ocean by the way of the Savannah River, on the steamer "City of Macon." As the steamer passed down the river for the first three miles a line of ocean ships and river craft gave a continuous salute by steam whistles and other demonstrations, while flags of every nation floated from stem to stern on every ship in the Savannah River. Along the banks of the river on either side were pointed out to the visiting delegates extensive rice plantations, some of which included thousands of acres and had at times yielded their proprietors a large percentage of interest on their investment. These rice plantations gave employment to a large number of men and necessitated the ownership of hundreds of mules sometimes on an individual plantation. From the low, flat and apparently wet land it seemed almost certain that aside from the mere earning capacity of a plantation there could be but little attractive interest in rice culture. I inferred from the general tone of remarks with regard to this industry that it was on the wane, and that nothing but protection by the general government would be successful in reviving it.

On our return to Savannah a banquet was served on the steamer, at which Mayor McDonough presided, and many of the guests and city officers made brief speeches. During the trip we had great opportunity to view the work of jetty construction and dredging in the harbor. After leaving the wharf, three wing dams, designed to contract the water ways, with a view of deepening the channel, were a feature of universal interest. A low spur dam at the lower end of Fig Island and a training wall constructed to straighten the channel had proved a perfect success, the training wall being six thousand feet long on the port side going down stream. If the river was of great consequence to the city before with its crooked channel and long bars, the improvement in conditions can hardly be estimated.

It is impossible in the brief space allotted me to give more in detail of the work of the Congress, the beauties of the city, the general enterprise of the people of Georgia, of the deep interest they took in the sessions of the Congress, and the universal hospitality extended. I can only add that everywhere, on all public occasions, no opportunity was lost in showing the high estimation in which the old Bay State and its capital city of Boston were held by the people of Georgia and its great seaport city of Savannah. That such gatherings of people from remote States will have a tendency to promote good fellowship, secure more harmonious business relations and extend that brotherly feeling upon which the rapid growth of the Republic must depend to a large extent, there can be no doubt. This exchange of sentiment and interchange of sympathy from people meeting to discuss trade relations and business industries perhaps entered but little into the original conception of the men who first instituted and originated the idea of the Congress.

From my own standpoint, having been delegated by your Excellency to represent the State of Massachusetts at Sedalia, Missouri, in 1891, and at Lincoln, Nebraska, in 1892, and for the third time at Savannah, Georgia, in 1893, and having at each of these gatherings taken an active part in the public proceedings, and carefully listened to addresses and discussions which were made and entered into by prominent practical men from all parts of the United States, and mingled with them in social conversation outside of the halls in which the public proceedings were conducted, I am free to say that the value of such social intercourse and personal acquaintance has no small influence in breaking down local prejudices, which are often based upon a complete ignorance of real conditions, and may be a cardinal feature in the intrinsic value of these annual gatherings. I therefore fully believe that it is in the interest of the several States of the United States to give such aid in the permanent support of this organization as may be in their power.

Respectfully submitted,

DANIEL NEEDHAM,

*Delegate at Large.*

DECEMBER 27, 1893.

# LAWS RELATING

TO THE

# STATE BOARD OF AGRICULTURE

AND

# INCORPORATED AGRICULTURAL SOCIETIES,

TOGETHER WITH THE

BY-LAWS OF THE BOARD OF AGRICULTURE AND RULES
AND RECOMMENDATIONS OF THE BOARD FOR THE
AGRICULTURAL SOCIETIES WHICH DRAW
STATE BOUNTY.

# STATUTES RELATING TO THE STATE BOARD OF AGRICULTURE.

## PUBLIC STATUTES. — CHAPTER 20.

### INDEX.

SECTION
1. Board, how constituted.
2. Tenure of office of members. Vacancies, how filled.
3. Where and how often to meet; to receive no compensation.
4. Secretary and clerk and their salaries.
5. Board to be overseers of agricultural college.

SECTION
6. Board to investigate subjects relating to agriculture, take donations, etc.
7. to fix days for annual meetings of agricultural societies, etc.
8. to report to general court.
9. Secretary to publish abstracts, etc.
10. may appoint agents.

Board, how constituted.
G. S. 16, § 1.
1866, 263, § 3.
1894, 144.

SECTION 1. The governor, lieutenant-governor and secretary of the commonwealth, the president of the agricultural college, the secretary of the board of agriculture, one person appointed from and by the Massachusetts society for promoting agriculture, one person appointed from and by each agricultural society which receives an annual bounty from the commonwealth, and three other persons appointed by the governor with the advice and consent of the council, shall constitute the state board of agriculture.

(Section 4 of chapter 206 of the Acts of 1874 provides that " the chemist of the State Board of Agriculture shall be *ex officio* a member of said board and state inspector of fertilizers.")

Tenure of office of members.
Vacancies, how filled.
G. S. 16, § 2.

SECT. 2. One-third of the appointed members of said board shall retire from office on the first Wednesday of February in each year, according to their appointments. The vacancies thus occurring shall be filled by the governor and council, or by the agricultural societies, as the offices were before filled, and the persons thus appointed shall hold their offices for three years from the expiration of the former terms. Other vacancies may be filled in the same manner for the remainder of the vacant terms.

Where and how often to meet.

To receive no compensation.
G. S. 16, § 3.
1866, 263, § 2.

SECT. 3. The board shall meet at the state house or at the agricultural college at least once in each year, and as much oftener as may be deemed expedient. No member of said board shall receive compensation from the commonwealth except for personal expenses when engaged in the duties of the board.

Secretary and clerks and their salaries.
G. S. 16, § 4.
1869, 96, § 2.
1879, 235.
1881, 264.
1883, 184.
1884, 66.
1887, 245.
1891, 300.
1892, 143.
1893, 120.

SECT. 4. The board may appoint and prescribe the duties of a secretary, who shall receive a salary of twenty-five hundred dollars a year; and who, at such times as the board shall approve, may employ a first clerk at a salary of sixteen hundred dollars a year, an assistant clerk at a salary of twelve hundred dollars a year, and may expend for other clerical services in his office, and for lectures to be given before the board of agriculture at its annual and other meetings, a sum not exceeding eight hundred dollars.

Board to be overseers of agricultural college.
1866, 263, § 1.

SECT. 5. The board shall be a board of overseers of the Massachusetts Agricultural College, with powers and duties to be defined and fixed by the governor and council, but such powers shall not control the action of the trustees of said college, or negative their powers and duties as defined by chapter two hundred and twenty of the acts of the year eighteen hundred and sixty-three.

to investigate subjects relating to agriculture, take donations, etc.
G. S. 16, § 5.

SECT. 6. The board shall investigate such subjects relating to improvement in agriculture in this commonwealth as they may think proper, and may take, hold in trust, and exercise control over donations or bequests made to them for promoting agricultural education or the general interests of husbandry.

Board to fix days for annual meetings of agricultural societies, etc.
G. S. 16, § 6.
1866, 189, § 3.

SECT. 7. They may fix the days on which the different agricultural societies shall commence their exhibitions, and may prescribe forms for and regulate the returns required of said societies, and shall furnish to the secretary of each society such blanks as they may deem necessary to secure uniform and reliable statistics.

to report to general court.
G. S. 16, § 7.

SECT. 8. They shall annually, on or before the fourth Wednesday of January, by their chairman or secretary, submit to the general court a detailed report of their doings, with such recommendations and suggestions as the interests of agriculture may require.

Secretary to publish abstracts, etc.
G. S. 16, § 8.

SECT. 9. The secretary of the board shall in each year cause to be made and published for distribution as full an abstract of the returns of the agricultural societies as he may deem useful.

may appoint agents.
G. S. 16, § 9.

SECT. 10. He may appoint one or more suitable agents to visit, under the direction of the board, the towns in the commonwealth for the purpose of inquiring into the methods and wants of practical husbandry; of ascertaining the adaptation of agricultural products to soil, climate, and markets; of encouraging the establishment of farmers' clubs, agricultural libraries, and reading-rooms; and of disseminating useful information in agriculture by means of lectures or otherwise; and such agents shall annually in October make to the secretary detailed reports.

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## An Act to provide for the Protection of Dairy Products and to establish a State Dairy Bureau.

[Chap. 412, Acts of 1891.]

Sale of butter regulated.

SECTION 1. Whoever sells or offers for sale, to any person who asks, sends or inquires for butter, any oleomargarine, butterine or any substance made in imitation of or semblance of pure butter, not made entirely from the milk of cows, with or without coloring matter, shall be declared guilty of fraud and punished by a fine of not less than one hundred dollars for each offence.

Oleomargarine, etc., packages to be plainly marked when offered for sale.

SECT. 2. Whoever exposes for sale oleomargarine, butterine or any substance made in imitation or semblance of pure butter, not marked and distinguished by all the marks, words and stamps required by existing laws, and not having in addition thereto upon every opened tub, package or parcel thereof a placard with the word "oleomargarine" printed thereon in plain, uncondensed gothic letters, not less than one inch long, shall be fined not less than one hundred dollars for each offence.

Penalty for selling the same unmarked.

SECT. 3. Whoever sells oleomargarine, butterine or any other substance made in imitation or semblance of pure butter, from any dwelling, store, office or public mart shall have conspicuously posted thereon the placard or sign, in letters not less than four inches in length, "oleomargarine sold here," or "butterine sold here," said placard to be approved by the bureau hereinafter provided for by this act. Any person neglecting or failing to post the placard herein provided for shall be punished by a fine of not less than one hundred dollars for the first offence and one hundred dollars for each day's neglect thereafter.

Wagons to be marked "licensed to sell oleomargarine."

SECT. 4. Whoever peddles, sells or delivers from any cart, wagon or other vehicle, upon the public streets or ways, oleomargarine, butterine or any substance made in imitation or semblance of pure butter, not having on both sides of said cart, wagon or other vehicle the placard in uncondensed gothic letters, not less than three inches in length, "licensed to sell oleomargarine," shall be punished by a fine of not less than one hundred dollars or imprisonment for not less than thirty days for each offence.

Guests at hotels, etc., to be notified when substance served is not butter.

SECT. 5. Whoever furnishes, or causes to be furnished, in any hotel, restaurant or at any lunch counter, oleomargarine or butterine to any guest or patron of such hotel, restaurant or lunch counter, in the place or stead of butter shall notify said guest or patron that the substance so furnished is not butter, and any party so furnishing without such notice shall be punished by a fine of not less than ten nor more than fifty dollars for each offence.

Assistant to the secretary of the board of agriculture to be appointed.

SECT. 6. The governor, by and with the consent of the council, shall appoint an assistant to the secretary of the board of agriculture, at an annual salary of twelve hundred dollars, and expenses necessarily incurred in the discharge of his duties, to assist in the work prescribed in the eleventh section of this act. Said appointee shall hold office for two years or till his successor is appointed, unless sooner removed from office by the governor, and his successor shall be appointed as above provided for.

Term of office.

Three members of the board of agriculture to constitute a dairy bureau.

SECT. 7. In order to secure the better enforcement of the provisions of this act and to promote the improvement of the products of the dairy, the governor, by and with the advice and consent of the council, shall appoint three members of the board of agriculture, to constitute a dairy bureau of said board, one to serve for three years, one for two years and one for one year from the first day of July in the year eighteen hundred and ninety-one, or for such shorter terms respectively as they may continue to be members of said board of agriculture; and, prior to the first day of July in each succeeding year, the governor shall appoint from said board one member of said bureau to serve for three years or for such shorter term, as aforesaid. No person shall continue to be a member of said bureau after he has ceased to be a member of said board, but, on his ceasing to be a member of said board, his place on said bureau shall be filled by the appointment of another member of said board, as aforesaid. The secretary of said board shall be the executive officer of said bureau subject to its control and direction, and said secretary shall, upon assuming said duties, receive, in addition to his present salary, five hundred dollars per annum. The governor may at any time terminate the service of any member of said board as a

Executive officer.

member of said bureau and may appoint any other member of said board in his place, as above provided. Members of said bureau shall serve without pay and shall have power to enforce all laws relating to dairy products and imitations thereof, and to employ such agents, assistants, experts, chemists or counsel as may be necessary therefor. Said bureau, in the discharge of its duties, shall be subject to the general direction and control of the board of agriculture.

Members of bureau to serve without pay; powers, etc. (See Acts 1892, chap. 139.)

Sect. 8. The bureau may expend a sum not exceeding four thousand dollars in carrying forward the work of the bureau, and shall make annual reports in detail to the legislature, not later than the fifteenth day of January in each year, of the number of assistants, experts, chemists, agents and counsel employed, and their expenses and disbursements, with such other information as shall be for the advantage of the dairy interests in the state, and they shall make full reports of all investigations made by them with all cases prosecuted and the results of such prosecution. They shall make detailed statements of the said expenses to the auditor of the Commonwealth, on which payment shall be made to the extent of the appropriation.

May expend not exceeding $4,000; reports.

To make detailed statements of expenses to the auditor of the Commonwealth.

Sect. 9. Said bureau and such agents and counsel as they shall duly authorize for that purpose shall have access, ingress and egress to and from all places of business, factories, buildings, carriages and cars, used in the manufacture and sale of any dairy products, or imitation dairy products, and shall have access to all vessels and cans used in such manufacture and sale, and shall have all the authority given by law to the state board of health and any officer thereof, and to the milk inspectors, in the enforcement of all laws relating to dairy products or imitations thereof, and in the prosecutions of violations of said laws.

To have access, etc., to places where dairy products are sold, etc.

Sect. 10. The said bureau may work in unison with the state board of health, and with inspectors of milk, but they shall not restrict, limit or interfere with the duties of said officers. Nothing herein contained shall be held to circumscribe the rights of said bureau in the prosecution of offenders of the so-called dairy laws, or all laws relating to milk, butter, cheese or any adulterations or imitations thereof, wherever found within the Commonwealth.

May work in unison with state board of health and inspectors of milk, etc.

Sect. 11. It shall be the duty of the said bureau to investigate all dairy products and imitation dairy products

To investigate dairy products and imitation dairy products, etc.

bought or sold within the Commonwealth; to enforce all laws for the manufacture, transfer and sale of all dairy products and all imitation dairy products within the Commonwealth, with all the powers needed for the same; to investigate all methods of butter and cheese making in cheese factories or creameries, and to disseminate such information as shall be of service in producing a more uniform dairy product, of higher grade, and better quality.

Fines payable to the treasury.

SECT. 12. All fines recovered under this act shall be payable to the treasury of the Commonwealth.

To take effect Sept. 1, 1891.

SECT. 13. This act shall take effect on the first day of September in the year eighteen hundred and ninety-one.

### An Act providing Compensation for the Members of the State Dairy Bureau.

[Chap. 139, Acts of 1892.]

Compensation of members of dairy bureau.

SECTION 1. From and after the first day of January in the year eighteen hundred and ninety-two the members of the state dairy bureau shall be allowed from the treasury of the Commonwealth five dollars a day for each day of actual service in the discharge of their duties as members of said bureau, in addition to their actual travelling expenses. The amount so allowed shall be paid from the sum now limited by section eight of chapter four hundred and twelve of the acts of the year eighteen hundred and ninety-one for carrying forward the work of said bureau.

SECT. 2. This act shall take effect upon its passage.

### An Act to authorize the State Board of Agriculture to collect and circulate Information relating to Abandoned Farms.

[Chap. 280, Acts of 1891.]

To obtain and circulate information relative to abandoned farms.

SECTION 1. The state board of agriculture is hereby authorized to collect all necessary information in regard to the opportunities for developing the agricultural resources of the Commonwealth through the repopulating of abandoned or partially abandoned farms, and cause the facts obtained, and a statement of the advantages offered, to be circulated where and in such manner as the said board may consider for the best interests of the Commonwealth.

Expenditures not to exceed $2,000.

SECT. 2. In order to properly carry out the provisions of section one of this act, a sum not exceeding two thousand dollars may be expended, and the bills for such expenditures properly approved by the persons authorized by said state board to investigate the matter, shall be sent to the auditor of the Commonwealth who shall certify them in the same manner as other claims against the Commonwealth.

SECT. 3. This act shall take effect upon its passage.

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### To provide against Depredations by the Insect known as the Ocneria dispar or Gypsy Moth.

[Chap. 210, Acts of 1891.]

**Extermination of the Ocneria dispar or gypsy moth.**

SECTION 1. The state board of agriculture is hereby authorized, empowered and directed to provide and carry into execution all reasonable measures to prevent the spreading and to secure the extermination of the ocneria dispar or gypsy moth in this Commonwealth; and to this end said board shall have full authority to provide all necessary material and appliances, and to employ such competent persons, servants and agents as it shall from time to time deem necessary in the carrying out the purposes of this act; and said board shall also have the right itself or by any persons, servants or agents employed by it under the provisions of this act to enter upon the lands of any person.

**Remedy of owner of land suffering damage.**

SECT. 2. The owner of any land so entered upon, who shall suffer damage by such entry and acts done thereon by said state board of agriculture or under its direction, may recover the same of the city or town in which the lands so claimed to have been damaged are situate, by action of contract; but any benefits received by such entry and the acts done on such lands in the execution of the purposes of this act shall be determined by the court or jury before whom such action is heard, and the amount thereof shall be applied in the reduction of said damages; and the Commonwealth shall refund to said city or town one-half of the amount of the damages recovered.

**Board of agriculture may make rules and regulations.**

SECT. 3. Said state board of agriculture shall have full authority to make from time to time such rules and regulations in furtherance of the purposes of this act as it shall deem needful, which rules and regulations shall be published in one or more newspapers published in the county of Suffolk; and copies of such rules and regulations shall be posted in at least three public places in each city or town in which said ocneria dispar or gypsy moth shall be found by said board to exist and a copy thereof shall be filed with the city clerk of each such city and with the town clerk of each such town; and any person who shall knowingly violate any of the provisions thereof shall be punished for each violation by a fine not exceeding twenty-five dollars.

To keep a record of its transactions and report to the general court.

SECT. 4. Said state board of agriculture shall keep a record of its transactions and a full account of all its expenditures under this act, and shall by its chairman or secretary make report thereof, with such recommendations and suggestions as said board shall deem necessary, on or before the fourth Wednesday in January, to the general court.

Compensation of agents and servants.

SECT. 5. Said state board of agriculture shall establish the rate of compensation of any persons, servants or agents employed by it under this act.

Penalty for obstructing agents engaged in executing purposes of act.

SECT. 6. Any person who shall purposely resist or obstruct said state board of agriculture, or any persons, servants or agents employed by it under the provisions of this act, while engaged in the execution of the purposes of this act, shall be punished by a fine not exceeding twenty-five dollars for each offence.

The insect or its eggs, etc., not to be brought into the state, etc., under penalty.

SECT. 7. It shall be unlawful for any person knowingly to bring the insect known as the ocneria dispar or gypsy moth, or its nests or eggs, within this Commonwealth; or for any person knowingly to transport said insect, or its nests or eggs, from any town or city to another town or city within this Commonwealth. Any person who shall offend against the provisions of this section shall be punished by a fine not exceeding two hundred dollars or by imprisonment in the house of correction not exceeding sixty days, or by both such fine and imprisonment.

Power of state board may be executed by secretary, etc.

SECT. 8. The said state board of agriculture may exercise all the duties and powers herein conferred upon said board, by and through its secretary and such members of said board as it may designate and appoint to have in charge, in conjunction with its secretary, the execution of the purposes of this act.

Moneys heretofore appropriated to be expended by the board.

SECT. 9. All moneys heretofore appropriated or authorized to be expended under the provisions of chapters ninety-five and one hundred and fifty-seven of the acts of the year eighteen hundred and ninety or by any other act, and not heretofore expended, are hereby appropriated and authorized to be expended by the said board in carrying out the purposes of this act.

Property acquired and records kept to be delivered to the board.

SECT. 10. All the property acquired and records kept under the provisions of said chapter ninety-five of the acts of the year eighteen hundred and ninety shall be delivered into the custody of said board, and said board is authorized to take, receive and use the same for the purposes of this act.

SECT. 11. Chapter ninety-five of the acts of the year eighteen hundred and ninety is hereby repealed, but all claims for damages under said chapter ninety-five for entry upon and acts done on the lands of any person may be prosecuted, as therein provided, against the city or town wherein the lands entered upon are situate, and the damages shall be ascertained and one-half of the amount thereof recovered against any city or town shall be refunded to such city or town as provided in said chapter ninety-five.

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## An Act relative to preserving Ornamental and Shade Trees on the Highways.

[Chapter 196, Acts of 1890.]

Shade, etc., trees to be designated and preserved.

SECTION 1. The mayor and aldermen of the cities and the selectmen of the towns within the Commonwealth are hereby authorized to designate and preserve, as hereinafter provided in this act, trees within the limits of the highways for the purposes of ornament and shade; and to so designate not less than one such tree in every thirty-three feet where such trees are growing and are of a diameter of one inch or more.

Method of designation. 1891, 49. 1892, 147.

SECT. 2. Said mayor and aldermen and selectmen shall designate such trees as are selected by them for the purposes set forth in this act by driving into the same, at a point not less than four nor more than six feet from the ground and on the side toward the centre of the highway, a nail or spike with a head with the letter M plainly impressed upon it; said nails and spikes to be procured and furnished by the secretary of the state board of agriculture to said mayor and aldermen and selectmen as required by them for the purposes of this act. Said mayor and aldermen and selectmen shall renew such of said nails and spikes as shall have been destroyed or defaced; and shall also designate, in the same manner as hereinbefore stated, such other trees as in their judgment should be so designated to carry out the requirements of this act.

Penalties.

SECT. 3. Whoever wantonly injures, defaces or destroys any tree thus designated, or any of said nails or spikes affixed to such trees, shall forfeit not less than five nor more than one hundred dollars, to be recovered by complaint, one-half to the complainant and one-half to the use of the town wherein the offence was committed.

Proviso.
P. S. 54.

SECT. 4. This act shall not apply to ornamental or shade trees whose preservation is now provided for by chapter fifty-four of the Public Statutes and the acts amendatory thereof.

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### An Act authorizing Towns and Cities to provide for the Preservation and Reproduction of Forests.

[Chap. 255, Acts of 1882, Sects. 1, 2, 3, 4, 5.]

Preservation and culture of forest trees by cities and towns.

SECTION 1. The voters of any town, at a meeting legally called for the purpose, and the city council of any city, may, for the purpose of devoting a portion of the territory of such town or city to the preservation, reproduction and culture of forest trees for the sake of the wood and timber thereon, or for the preservation of the water supply of such town or city, take or purchase any land within the limits of such town or city, may make appropriations of money for such taking or purchase, may receive donations of money or land for the said purposes, and may make a public domain of the land so devoted, subject to the regulations hereinafter prescribed. The title of all lands so taken, purchased or received shall vest in the Commonwealth, and shall be held in perpetuity for the benefit of the town or city in which such land is situated.

Description of the land taken to be recorded in the registry of deeds.

SECT. 2. A town or city taking land under this act shall, within sixty days after such taking, file and cause to be recorded in the registry of deeds for the county or district in which the land is situated a description thereof sufficiently accurate for identifying the same. In case such town or city and the owner of such land do not agree upon the damage occasioned by such taking, such damage shall be ascertained and determined in the manner provided in case of the taking of land for a highway in such town or city, and such town or city shall thereupon pay such sums as may finally be determined to be due.

Board of forestry to serve without pay; to appoint keepers.

SECT. 3. The state board of agriculture shall act as a board of forestry, without pay, except for necessary travelling expenses, and shall have the supervision and management of all such public domains, and shall make all necessary regulations for their care and use and for the increase and preservation of the timber, wood and undergrowth thereon, and for the planting and cultivating of trees therein. The said board shall appoint one or more persons, to be called keepers, to have charge, subject to its direction, of each such public domain, enforce its regulations and perform such labor thereon as said board shall require; and said keepers shall have the same power to protect such domain from injury and trespass, and to keep the peace therein as constables and police officers in towns.

may lease buildings on land.

Proceeds of sale of products to be paid to board.

SECT. 4. Said board may lease any building that may be on any such public domain on such terms as it shall deem expedient. All sums which may be derived from rents and from the sale of the products of any such domain shall be paid to said board and shall be applied by it, so far as necessary, to the management, care, cultivation and improvement of such domain; and any surplus remaining in any year shall be paid over to the city or town in which such domain is situated. Said board shall not, however, expend upon or on account of any such public domain in any year a greater amount than it receives as aforesaid.

Buildings for instruction and recreation may be built.

SECT. 5. A city or town in which any such public domain is situated may erect thereon any building for public instruction or recreation, provided that such use thereof is not in the judgment of said board inconsistent with the purposes expressed in section one.

## *An Act to establish an Agricultural Experiment Station.

[Chap. 212, Acts of 1882, Sects. 1, 2, 3.]

Experiment station established.

SECTION 1. An agricultural experiment station shall be established and maintained at the Massachusetts agricultural college in the town of Amherst.

Management vested in board of control.

SECT. 2. The management of said station shall be vested in a board of control of seven persons of which

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*Chapter 143 of the Acts of 1894 provides for the consolidation of the Massachusetts Experiment Station with the Experiment Department of the Massachusetts Agricultural College.

board the governor shall be president ex officio, and of which two members shall be elected from the state board of agriculture, by said board of agriculture; two from the trustees of the Massachusetts agricultural college, by said trustees; one from the Massachusetts society for promoting agriculture, by said society; and the remaining member shall be the president of the Massachusetts agricultural college. The said board shall choose a secretary and treasurer.

[Section 2 has been amended by Acts of 1888, chap. 333, sect. 1, so as to read as follows: — The management of said station shall be vested in a board of control of eleven persons, of which board the governor shall be president ex officio, and of which two members shall be elected from the state board of agriculture, by said board of agriculture; two from the trustees of the Massachusetts agricultural college, by said trustees; one from the Massachusetts society for promoting agriculture, by said society; one from the Massachusetts state grange, by said state grange; one from the Massachusetts horticultural society, by said society; and the remaining members shall be the president of the Massachusetts agricultural college, the director of the Massachusetts agricultural experiment station and the secretary of the state board of agriculture: *provided, however*, that no person so elected by any of the above named boards or societies shall continue to be a member of said board of control after he has ceased to be a member of the board or of the society by which he was elected. The said board shall choose a secretary and treasurer.]

Proviso.

Board to make report to the legislature.

SECT. 3. The said board of control shall hold an annual meeting in the month of January, at which time it shall make to the legislature a detailed report of all moneys expended by its order, and of the results of the experiments and investigations conducted at said station, with the name of each experimenter attached to the report of his own work, which detailed report shall be printed in the annual report of the secretary of the state board of agriculture.

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### An Act relating to the Annual Report of the Board of Control of the Agricultural Experiment Station.

[Chap. 105, Acts of 1883.]

Agricultural experiment station to

The board of control of the agricultural experiment station shall annually, in the month of January, make a detailed report to the state board of agriculture of all moneys expended by its order, and of the results of the experiments and investigations conducted at said station, with the name of each experimenter attached to the report of his own work.

make annual report to board of agriculture.

### Board of Supervisors of Statistics.

[P. S., Chap. 31, Sect. 17.]

SECT. 17. The secretary of the commonwealth, the secretaries of the boards of agriculture, of education, and of the state board of health, lunacy, and charity, and the chief of the bureau of statistics of labor, shall constitute a board of supervisors of statistics, who shall serve without pay.

Board of supervisors of statistics. Res. 1877, 60.

### An Act concerning the Printing and Distribution of Certain Reports and Public Documents.

[Chap. 369, Acts of 1885, Sect. 1.]

SECTION 1. There shall be printed annually the number of copies of documents and reports specified in this section, the same to be numbered in the series of Public Documents, and distributed as herein provided: Report of secretary of board of agriculture, twelve thousand copies; twenty-five copies thereof to be furnished to each member of the legislature.

Documents and reports.

Agriculture.

This has been amended by Acts of 1888, chap. 256: —

SECT. 1. There shall be printed annually fifteen thousand copies of the report of the secretary of the state board of agriculture; and twenty-five thousand copies of the report of the board of control of the state agricultural experiment station.

Additional reports of the secretary of the state board of agriculture, etc.

SECT. 2. Of the reports of the board of control of the state agricultural experiment station provided for in section one of this chapter, fifteen thousand copies shall be bound with the reports of the secretary of the state board of agriculture, and eight thousand copies shall be for the use of the said board of control.

### Printing and Distribution of Public Documents.

[P. S., Chap. 4, Sect. 11.]

SECT. 11. The treasurer, auditor, attorney-general, adjutant-general, board of education, and board of agriculture, may require any portion of their reports to be put

Report of the board of agriculture may be put in type in advance.

in type previous to the first Wednesday in January annually, when the same can be done consistently with the public advantage.

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### An Act for the Suppression of Contagious Diseases among Domestic Animals.

[Chap. 252, Acts of 1887, Sect. 19.]

Abstract of report of cattle commissioners to be printed in report of board of agriculture.

SECT. 19. Cattle commissioners now or hereafter appointed shall keep a full record of their doings, and report the same to the legislature on or before the tenth day of January in each year unless sooner required by the governor; and an abstract of the same shall be printed in the annual report of the state board of agriculture.

# STATUTES RELATING TO AGRICULTURAL AND HORTICULTURAL SOCIETIES.

## PUBLIC STATUTES.—CHAPTER 114.

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SECTION
1. Agricultural societies may be entitled to annual sum from the treasury, by, etc.
2. Societies claiming bounty to file certificate.
3. Amount of bounty. State board may withhold the same.
4. Societies may make rules for distribution of bounty.
5. to make annual returns, with passages, etc., marked.
6. Forfeiture of bounty.
7. Premiums to be offered by societies, etc.
8. for trees for ship timber.
9. All citizens of county may become members, and compete for premiums.
10. Surplus to be at interest.
11. To what societies provisions apply.
12. Cattle shows regulated.
13. Penalty.
14. Extent of foregoing provisions.

SECTION
15. Marshals to be appointed; to have powers of constables.
16. Rules for ascertaining amount of premium crops.
17. Premiums for experiments.

ASSOCIATIONS FOR ENCOURAGING AGRICULTURE, ETC.

18. Ten or more persons may become a corporation. Powers and privileges.

FARMERS' CLUBS.

19. Farmers' clubs to receive publications, etc.

GOOD ORDER AT FAIRS, ETC.

20. Societies, etc., may make regulations for preservation of peace at fairs, etc.
21. Booths, etc., not to be established within half mile of cattle shows, without consent. Gaming, etc., prohibited.
22. Penalty.

SECTION 1. Every incorporated agricultural society which was entitled to bounty from the commonwealth before the twenty-fifth day of May in the year eighteen hundred and sixty-six, and every other such society whose exhibition grounds and buildings are not within twelve miles of those of a society then entitled to bounty, and which has raised by contribution of individuals and put out at interest on public or private security, or invested in real estate, buildings, and appurtenances for its use and accommodation, one thousand dollars, as a capital appropriated for its uses, shall, except when otherwise determined by the state board of agriculture as provided in section three, be entitled to receive in the month of October annually, out of the treasury of the commonwealth, two hundred dollars, and in that proportion for

Agricultural societies may be entitled to annual sum from the treasury, by, etc.
G. S. 66, § 1.
1866, 189, § 1.
1870, 258.
1881, 285.
1890, 297.

any greater sum so contributed and put at interest or invested; but no society shall receive a larger amount in one year than it has awarded and paid in premiums during the year last preceding, nor more than six hundred dollars: *provided*, that if there is only one incorporated agricultural society in any county, such society shall be entitled to receive said bounty notwithstanding its exhibition grounds and buildings are within twelve miles of a society entitled to said bounty; and *provided*, *further*, that such society shall not after having received said bounty forfeit the right to receive the same by reason of the subsequent incorporation of another society within the same county.

Societies claiming bounty to file certificate. G. S. 66, § 2. 1891, 124.

SECT. 2. Every society which claims bounty shall annually, on or before the tenth day of January, file in the office of the secretary of the board of agriculture, a certificate signed by its president and treasurer, specifying under oath the sum so contributed and put at interest or invested, and then held so invested or well secured as a capital stock; and also such other returns of their financial affairs as the board of agriculture may require, upon a blank to be furnished by the secretary of the board of agriculture to the treasurer of such societies.

Amount of bounty. State board may withhold same. G. S. 66, § 3. 1881, 285.

SECT. 3. The amount of bounty to which a society is entitled for any year shall be ascertained by the certificate last filed by it under the preceding section. But a society shall not receive bounty in any year, if the state board of agriculture, having first given such society full opportunity to be heard in relation to its financial affairs and general management, so determines by a two-thirds vote of the whole number of its members present at its annual meeting, and by its secretary notifies the treasurer of the commonwealth thereof on or before the first day of September in such year.

Societies may make rules, etc., for distribution of bounty. 1865, 90, § 1.

SECT. 4. Every society receiving bounty shall make such rules and regulations for the distribution thereof as shall, in its opinion, best promote the improvement of agriculture; subject, however, to the restrictions of sections six to ten inclusive.

to make annual returns, with passages, etc., marked. G. S. 66, § 5. 1874, 182.

SECT. 5. Every such society shall annually, on or before the tenth day of January, make a full return of its doings, signed by its president and secretary, to the secretary of the board of agriculture, embracing a statement of the expenditure of all money, specifying the nature of the encouragement proposed by the society, the objects for which its premiums have been offered, and the persons to whom they have been awarded, and including all reports of committees and all statements of experiments and cultivation regarded by the president and secretary as worthy of publication, and with such general observations concerning the state of agriculture and manufactures in the commonwealth as it may deem useful.

The return shall be marked in such manner that the passages deemed by such officers most worthy of public notice, study, and application may be easily distinguished.

Forfeiture of bounty. G. S. 66, § 6.

SECT. 6. A society which neglects in any year to comply with the laws relating thereto, or with the regulations of the board of agriculture, shall not be entitled to bounty in the year next succeeding.

Premiums to be offered by societies, etc. G. S. 66, § 7.

SECT. 7. Every society which receives said bounty shall offer annually by way of premiums, or shall otherwise apply for the encouragement or improvement of agriculture or manufactures, a sum not less than the amount so annually received, and shall offer such premiums for agricultural experiments and in such manner as the state board of agriculture requires.

for trees for ship timber. G. S. 66, § 8.

SECT. 8. Every such society shall annually offer such premiums and encouragement for the raising and preserving of oaks and other forest trees as to it seems proper and best adapted to perpetuate within the commonwealth an adequate supply of ship timber.

All citizens of county may be members, etc. 1861, 180, § 1.

SECT. 9. Every such society shall admit as members, upon equal terms, citizens of every town in the county in which it is located, and all premiums offered shall be subject to the competition of every citizen of such county.

Surplus to be at interest. G. S. 66, § 9.

SECT. 10. All money offered for premiums which is not awarded or paid shall be put out at interest and added to the capital stock of the society.

To what societies provisions apply. G. S. 66, § 10. 1881, 285.

SECT. 11. The foregoing provisions, except the proviso in section three authorizing the state board of agriculture to withhold bounty, shall not, except by special enactment, extend to an agricultural society incorporated for any territory less than a county.

Cattle shows regulated. G. S. 66, § 11. 6 Allen, 588.

SECT. 12. Every society may by its officers define and fix bounds of sufficient extent for the erection of its cattle pens and yards, and for convenient passage ways to and about the same, on the days of its cattle shows and exhibitions, and also for its ploughing matches and trials of working oxen; within which bounds no persons shall be permitted to enter or pass unless in conformity with the regulations of the officers of the society.

Penalty. G. S. 66, § 12.

SECT. 13. Whoever contrary to such regulations, and after notice thereof, enters or passes within the bounds so fixed, shall forfeit a sum not exceeding five dollars.

Limit of bounds. G. S. 66, § 13. 6 Allen, 588.

SECT. 14. The foregoing provisions shall not authorize a society to occupy or include within such bounds the land of any person without his consent, nor to obstruct travel on any public highway.

Marshals to be appointed; to have powers of constables. G. S. 66, § 14. 6 Allen, 588.

SECT. 15. The officers of each society may appoint a sufficient number of suitable inhabitants of the county to act as marshals at cattle shows and exhibitions, who shall have the powers of constables in relation to the preservation of the public peace and the service and execution of criminal process within the respective towns where such shows and exhibitions are held, and such process may be directed to them accordingly; and they shall exercise their office from twelve o'clock at noon of the day preceding the commencement of such shows and exhibitions until twelve o'clock at noon of the day succeeding the termination thereof, and no longer.

Rules for ascertaining the amount of premium crops. 1862, 24, § 1.

SECT. 16. The state board of agriculture may prescribe rules and regulations to societies for uniform modes of ascertaining the product of crops entered for premium.

Premiums for experiments. 1881, 285.

SECT. 17. Any agricultural society may offer and pay premiums for experiments in the cultivation of crops or in the raising of domestic animals for farm purposes, and no regulation of the board of agriculture to the contrary shall be valid.

### ASSOCIATIONS FOR ENCOURAGING AGRICULTURE, ETC.

Ten or more persons may become a corporation. Powers and privileges. G. S. 66, § 17.

SECT. 18. Ten or more persons in any county, city, or town, who by agreement in writing associate for the purpose of encouraging agriculture or horticulture, or for improving and ornamenting the streets and public squares of any city or town by planting and cultivating ornamental trees therein, may become a corporation by such name as they assume therefor upon calling their first meeting and organizing in the manner provided in sections twelve and thirteen of chapter forty; and shall thereupon during the pleasure of the general court have for their purposes all the rights, powers, and privileges given by sections twelve to fifteen, inclusive, of said chapter, and may hold real and personal estate not exceeding ten thousand dollars in value.

### FARMERS' CLUBS.

Farmers' clubs to receive publications, etc. G. S. 66, § 18.

SECT. 19. Farmers' clubs properly organized and holding regular meetings shall, upon application made annually in November to the secretary of the state board of agriculture, receive copies of its report and of its other publications, in proportion to the number of their members and to the applications so made. Every club receiving such copies shall annually in October make returns to said secretary of its agricultural experiments and of the reports of its committees.

### GOOD ORDER AT FAIRS, ETC.

Societies, etc., may make regulations for preservation of peace at fairs, etc. 1861, 127, § 1. 6 Allen, 588.

SECT. 20. Any agricultural society or farmers' club may establish such regulations, not repugnant to law, as it may deem necessary and expedient for the preservation of peace and good order or for the protection of its interests at its regular or annual meetings, shows, fairs, or exhibitions, and shall cause at least five copies of such regulations to be posted in as many public places on its grounds not less than forty-eight hours before the time of holding each meeting.

Booths, etc., for sale of goods, not to be established within half mile of cattle shows, etc., without consent.

Gaming, horse-racing, etc., prohibited. 1861, 127, § 2. 1877, 149, § 1.

SECT. 21. No person during the time of holding a cattle show, fair, or exhibition, or meeting of a farmers' club, without the consent of the proper authorities having charge of the same, shall establish within one-half mile of the place of holding such show or meeting a tent, booth, or vehicle of any kind for the purpose of vending any goods, wares, merchandise, provisions, or refreshments. No person shall engage in any gaming or horse-racing or exhibit any show or play during the regular or stated time of holding any cattle show, agricultural fair, or meeting of any farmers' club, or engage in pool-selling, at or within half a mile of the place of holding the same: *provided*, that any person having his regular place of business within such limits shall not be hereby required to suspend his business.

Penalty. 1861, 127, § 3.

SECT. 22. Whoever violates any provision of the preceding section, or a regulation established under section twenty, shall forfeit for such offence a sum not exceeding twenty dollars.

### An Act concerning Real Estate owned by Certain Agricultural Societies.

[Chap. 274, Acts of 1890.]

Mortgage or sale of real estate of incorporated agricultural societies. P. S. 114.

SECTION 1. No incorporated agricultural society which has received or which may receive a bounty from the treasury of the Commonwealth under the provisions of chapter one hundred and fourteen of the Public Statutes shall mortgage or sell the whole or any portion of its real estate until authority for such sale or mortgage has been granted by the affirmative vote of two-thirds of the members of such society, present and voting at a meeting duly called for that purpose, and the vote has been approved by the State Board of Agriculture after due notice to parties interested and a hearing thereon.

SECT. 2. This act shall take effect upon its passage.

### An Act providing for the Assignment of Police Officers for Special Service at Agricultural and Horticultural Exhibitions.

[Chap. 180, Acts of 1892.]

Police officers at agricultural exhibitions, etc.

On the application of the president of an incorporated agricultural or horticultural society to the proper authorities of a town or city in which an exhibition of such society is to be held, said town or city authorities shall assign for special service at such exhibition as many police officers or constables as may be necessary to preserve the peace and enforce the laws of the Commonwealth at such exhibition.

### Property and Persons exempted from Taxation.

[P. S., chap. 11.]

Estate of agricultural societies. G. S. § 5, cl. 9. 116 Mass. 189, 191.

SECT. 5. The following property and polls shall be exempted from taxation: . . . . . . .

Ninth, The estate, both real and personal, of incorporated agricultural societies.

### Of Gaming.

[P. S., chap. 99.]

Gaming at cattle shows, musters, etc. G. S. 85, § 9.

SECT. 11. Whoever during or within twelve hours of the time of holding a cattle-show, military muster, or public gathering, within one mile of the place thereof, practises or engages in any gambling or unlawful game, shall forfeit for each offence a sum not exceeding twenty dollars. If he is discovered in the act, he may be arrested by any sheriff, deputy-sheriff, constable, or other civil officer, and lawfully detained, by imprisonment in jail or otherwise, not exceeding twenty-four hours, until a complaint is made against him for the offence.

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### Of the Suppression of Common Nuisances.

[P. S., chap. 101.]

Booths, etc., used for gaming, etc., near public shows, etc., how removed. G. S. 87, § 10.

SECT. 10. The mayor and aldermen or selectmen of any place, upon complaint made to them under oath that the complainant has reason to believe and does believe that a booth, shed, or other temporary erection, situated within one mile of a muster-field, cattle-show ground, or other place of public gathering, is used and occupied for the sale of spirituous or fermented liquor, or for the purpose of gaming, may, if they consider the complaint well founded, order the owner or occupant thereof to vacate and close the same forthwith. If the owner or occupant refuses or neglects so to do, the mayor and aldermen or selectmen may forthwith abate such booth, shed, or erection as a nuisance, and pull down or otherwise destroy the same in any manner they choose, or through the agency of any force, civil or military.

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### Of Offences against Public Policy.

[P. S., chap. 209.]

Racing, etc., declared unlawful.

SECT. 11. All racing, running, trotting, or pacing of a horse or other animal of the horse kind for a bet or wager of money or other valuable thing, or for a purse or stake, made within this State, except trials of the speed of horses for premiums offered by legally constituted agricultural societies, is declared to be unlawful; and any person engaged in such racing, running, trotting, or pacing, for any such bet or wager, purse or stake, or aiding or abetting the same, shall be punished by fine not exceeding one thousand dollars, or imprisonment in the jail not exceeding one year, or by both such fine and imprisonment.

Penalty. G. S. 167, § 9. 1865, 67. 102, Mass. 405.

# BY-LAWS OF THE MASSACHUSETTS STATE BOARD OF AGRICULTURE.

## CHAPTER I.

### Officers.

Officers and committees, how constituted.

Article 1. The officers of the Massachusetts State Board of Agriculture shall be a president, two vice-presidents, a secretary, and eight standing committees; said committees to consist of five members each, except the executive committee, which shall consist of seven members, and be composed of the chairmen of the seven other committees. The eight standing committees shall be: —

1. An executive committee.
2. A committee on agricultural societies.
3. A committee on domestic animals and sanitation.
4. A committee on gypsy moth, insects and birds.
5. A committee on dairy bureau and agricultural products.
6. A committee on agricultural college and education.
7. A committee on experiments and station work.
8. A committee on forestry, roads, and roadside improvements.

Officers, how elected.

Art. 2. The Governor of the Commonwealth shall be *ex-officio* president of the Board. The vice-presidents and secretary shall be elected annually by ballot. The standing committees shall be appointed by the chair at the annual meeting, with approval of the Board, except that the committee on dairy bureau and agricultural products shall include the three members designated by the Governor, as provided in chapter 412 of the Acts of 1891, and the committee on experiments and station work shall include the two members of the Board of Control of the State Experiment Station elected by the Board of Agriculture, as provided by chapter 333 of the Acts of 1888.

Special committees.

Art. 3. The secretary of the Board shall be an *ex-officio* member of each standing committee. Special committees may be chosen from time to time, as the Board may deem expedient.

## CHAPTER II.

### SPECIALISTS.

Duties of specialists; how paid.

ARTICLE 1. The Board shall also elect annually, by ballot, six specialists, to wit: a chemist, a veterinarian, an entomologist, an ornithologist, an engineer, a botanist and a pomologist. These specialists shall consider such matters as may be referred to them from time to time and report to the Board or to some committee thereof, and shall be paid for their services out of any funds available for such work, either per diem or at such rate as may be agreed upon with the secretary of the Board. They shall also be expected to attend, without pay, the public winter meeting of the Board, and also the annual meeting, and take part therein, but they shall not be entitled to a vote except in the case of the chemist, who by law is made a member of the Board.

## CHAPTER III.

### DUTIES OF OFFICERS AND COMMITTEES.

Duties of officers.

ARTICLE 1. The officers of this Board are charged with the duties and entitled to the rights and privileges which belong by general consent and parliamentary custom to their respective offices.

ART. 2. The president or one of the vice-presidents shall preside at all meetings of the Board.

### THE SECRETARY.

Duties of secretary.

ART. 3. The secretary of the Board shall keep the records of all meetings of the Board, and as full an abstract of the returns of the agricultural societies as may be deemed useful. He shall have the custody and care of all books, documents, and papers relating to matters which may come within the jurisdiction of the Board of Agriculture, and shall keep the same properly filed and indexed. He shall keep a full and accurate account of all moneys which may be placed at the disposal of the Board of Agriculture, also of bounties and other moneys which may be expended under its direction or in its behalf. He "shall furnish to the secretary of each agricultural society from time to time such printed forms and blanks as may be deemed necessary to secure uniform and reliable statistics," and any other information that may be called for by the Board. He shall annually, on or before

Duties of secretary continued.

the first Wednesday in January, with the approval of the Board, submit to the General Court such parts of his annual report as contain recommendations and suggestions for legislation in the interests of agriculture, and shall in each year cause to be made and published with his full report, in a volume for distribution, as full an abstract of the doings of the Board and of the returns of the agricultural societies as he may deem useful, which volume, to be known as the "Agriculture of Massachusetts," shall be completed, printed, presented to the General Court, and distributed as soon as possible after the annual meeting of the Board. (See Public Statutes, chapter 20, sections 7, 8 and 9, and chapter 144, Acts of 1893.)

Attend institutes.

The secretary shall, as opportunity offers, attend institutes, agricultural fairs, and other meetings in the interests of the agriculture of the State, or he may delegate this work, if his time will not permit, to agents, as provided for in chapter 20, section 10, of the Public Statutes.

Prepare papers, etc.

The secretary or his assistants shall also prepare subjects for discussions at institutes and public meetings, and shall collate and tabulate, from time to time, such information as may be of service to the State.

Librarian and curator.

The secretary shall appoint one of his clerks librarian and curator, who shall act under his directions.

## THE EXECUTIVE COMMITTEE.

Duties of executive committee.

ART. 4. All matters relating to the general welfare of the Board or the agriculture of the State, as well as all legislative measures, shall be referred to this committee. It shall have general oversight of all moneys expended by the Board or under its direction, or taken in trust or donated to it, as well as of all accounts and records of the Board; it shall also have general oversight of the editing and printing of the annual report and all other publications of the Board, and shall have all the powers of the Board not otherwise delegated until the next meeting of the Board, and shall report to the Board at the annual meeting.

Powers not otherwise delegated.

## THE COMMITTEE ON AGRICULTURAL SOCIETIES.

Duties of committee on agricultural societies.

ART. 5. All matters relating to the exhibitions of agricultural societies, the fixing of the dates of the same, the appointment of inspectors, the making of regulations governing the exhibitions, and the approval of premium lists, shall be referred to this committee, who shall consider the same and report to the Board.

### THE COMMITTEE ON DOMESTIC ANIMALS AND SANITATION.

Duties of committee on domestic animals and sanitation.

ART. 6. All matters relating to domestic animals and the sanitation of farms and farm buildings shall be referred to this committee, who shall consider the same from time to time, and report to the Board.

### THE COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.

Duties of committee on gypsy moth, insects and birds.

ART. 7. It shall be charged with the duties of the gypsy moth committee, as provided for in chapter 210 of the Acts of 1891. All matters relating to birds and insects shall be referred to this committee, who shall report to the Board from time to time.

### THE COMMITTEE ON DAIRY BUREAU AND AGRICULTURAL PRODUCTS.

Duties of committee on dairy bureau and agricultural products.

ART. 8. All matters relating to products of the farm or the dairy shall be referred to this committee, who shall report to the Board from time to time. (See chapter I., article 2.)

### THE COMMITTEE ON AGRICULTURAL COLLEGE AND EDUCATION.

Duties of committee on agricultural college and education.

ART. 9. All matters relating to agricultural education, lectures, the providing for institutes and public meetings of the Board, shall be referred to this committee, who shall have general oversight of the work, under the direction of the Board. This committee shall also be charged with the duties of the Board as Overseers of the Massachusetts Agricultural College, as provided for in chapter 20, section 5, of the Public Statutes. They shall visit the college from time to time, to inspect the property, observe the methods, extent, and character of the instruction there given, attend the commencement exercises and examinations, and make report of their doings and observations to the Board, with any suggestions and recommendations they may deem proper, as prescribed by the Governor and Council, May 12, 1886, and recorded in "Agriculture of Massachusetts," 1888, page 396.

## THE COMMITTEE ON EXPERIMENTS AND STATION WORK.

Duties of committee on experiments and station work.

ART. 10. All matters relating to experiments or the Experiment Station of the State shall be referred to this committee, who shall report to the Board from time to time. (See chapter I., article 2.)

## THE COMMITTEE ON FORESTRY, ROADS AND ROADSIDE IMPROVEMENTS.

Duties of committee on forestry, roads and roadside improvements.

ART. 11. This committee shall be charged with the duties of the Board of Forestry, under chapter 255 of the Acts of 1882; and all matters relating to forest fires, the preservation of forests, reforestation and reservation of public lands for the culture of forest trees, also all matters relating to roads and roadside improvements, shall be referred to this committee, who shall consider the same from time to time, and report to the Board.

## INSPECTORS.

Duties of inspectors.

ART. 12. The Board shall delegate members, who shall be known as inspectors, to visit each year the exhibitions held by the different agricultural societies which draw State bounty. Each inspector shall visit the society to which he may be assigned, observe the methods, character, and extent of its exhibition, inspect the property of the society, and make report, with suggestions and recommendations concerning the society, to the secretary of the Board, who shall submit each report to the committee on agricultural societies, and who shall also send such reports to the secretary of each society for publication in the local paper or the annual report of said society. If such inspector be unable to fill the appointment, he may exchange with any other inspector; but, in case he cannot make such exchange, he shall seasonably notify the secretary, who shall appoint a substitute. If no inspector appears at the exhibition of a society, it shall be the duty of the delegate from that society to make report to the secretary of the Board, in the same form as is required of the inspector.

Filling of vacancies.

Badges.

ART. 13. Members of the Board, when attending to their duties on the Board or as inspectors of the societies, shall be provided with a badge to be worn while in the performance of their duties.

## CHAPTER IV.

### MEETINGS OF THE BOARD.

Regular meetings.

ARTICLE 1. The Board shall meet at the State House, in the office of the State Board of Agriculture, or at the Agricultural College, as provided for in chapter 20, section 3, of the Public Statutes, at least once in each year, and as much oftener as may be deemed expedient. The annual business meeting shall begin on the Tuesday preceding the first Wednesday in February, this meeting to be known as the annual meeting. New members shall take their seats on the morning of the second day, after which officers for the ensuing year shall be chosen. There shall also be held an annual public winter meeting of the Board for lectures and discussions at such place in the Commonwealth as the Board may designate, beginning on the first Tuesday in December.

Annual meeting.

Public winter meeting.

Special meetings.

ART. 2. Special meetings may be called at any time by the secretary, with the consent of the executive committee, or at the written request of seven members of the Board. Such request shall be made to the secretary, who shall thereupon give notice of the same, stating therein the object for which the meeting is called.

Notice of meetings.

ART. 3. Notice of all meetings of the Board shall be given by the secretary in writing, by mail, to each member thereof, at least seven days prior to the date of meeting. The secretary shall also give due notice of committee meetings to members of the respective committees.

## CHAPTER V.

### ADMISSION OF DELEGATES AND COMPENSATION OF OFFICERS AND MEMBERS OF THE BOARD.

Credentials of delegates.

ARTICLE 1. The credentials of members of the Board shall be examined by the executive committee on the first day of the annual meeting; and the new delegates whose credentials are satisfactory shall be admitted to the annual meeting on the second day, at the morning session of the Board, at which time their term of office shall begin.

Compensation.

ART. 2. "No member of the Board shall receive compensation from the Commonwealth except for personal expenses when engaged in the duties of the Board," as provided for in chapter 20, section 3, of the Public Statutes.

Secretary, term of office and compensation.

Art. 3. The term of office of the secretary of the Board shall be for one year, beginning with the first of July following the election. The compensation of the secretary is $2,500 per year, and at the same rate for any part of a year, as provided for in chapter 184 of the Acts of 1883.

Clerks, compensation of.

Art. 4. The compensation of the first clerk is $1,600, as provided for in chapter 143, Acts of 1892; and the compensation of the assistant clerk is $1,200, as provided for in chapter 130, Acts of 1893.

## CHAPTER VI.

### Quorum.

Quorum of Board and committees.

Article 1. At all meetings of the Board eighteen members shall constitute a quorum for business. At all meetings of the executive committee four members shall constitute a quorum. At all meetings of other standing committees three members shall constitute a quorum.

## CHAPTER VII.

### Amendments.

Amendments and notice of meetings.

Article 1. These by-laws may be changed or amended, and additional by-laws may be adopted, at any annual meeting of the Board, or at any regularly called meeting, provided notice has been given in writing to each member at least seven days before such meeting, such notice to be issued by the secretary of the Board, stating the change or changes proposed.

## CHAPTER VIII.

### Order of Business.

Order of business.

Article 1. The business of the Board shall be conducted in accordance with rules used by deliberative bodies, and shall be transacted substantially in the following order; but the election of officers, appointment of standing committees, and introduction of new business shall not take place until after the admission of new members: —

1. Reading of the call of the meeting.
2. Calling of the roll of delegates at each session.
3. Reading of the report of the last meeting.

4. Report of executive committee on credentials of members.
5. Appointment of special committees.
6. Report of the secretary.
7. Reports of committees.
8. Reports of inspectors and agents.
9. Any unfinished business.
10. Election of officers.
11. The reading of papers.
12. New business.
13. Appointment of standing committees.
14. Assignment of inspectors.
15. Adjournment.

# RULES AND RECOMMENDATIONS FOR THE AGRICULTURAL SOCIETIES WHICH DRAW STATE BOUNTY.

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The following rules and recommendations are founded upon the Public Statutes, chapter 114, section 6, which reads as follows: —

> A society which neglects in any year to comply with the laws relating thereto, or with the regulations of the Board of Agriculture, shall not be entitled to bounty in the year next succeeding.

**Amount of bounty, how predicated.**

RULE 1. Every incorporated agricultural society which was entitled to bounty from the Commonwealth before the twenty-fifth day of May in the year 1866, and any agricultural society which is the only one incorporated within the limits of the county, and every other such society made competent by special enactment, whose exhibition grounds and buildings are not within twelve miles of any other society drawing bounty, may receive annually, in the month of October, a bounty of $200 from the State for $1,000 raised by contribution of individuals and put out at interest on public or private security, or invested in real estate for its use and accommodation, as capital, and it may draw an additional sum of $200 for each $1,000 so invested; but in no case shall a society draw more than $600 as bounty in one year, nor more than it has paid out in the previous year for premiums. (See Public Statutes, chapter 114, sections 1, 7 and 11; also Acts of 1890, chapter 297.)

**Financial returns.**

RULE 2. The president and treasurer of each incorporated society claiming bounty must specify under oath the sum so contributed and put at interest or invested, and then held so invested or well secured as a capital stock, and also such other returns of their financial affairs as the Board of Agriculture may require on a blank to be furnished by the secretary of the said Board to the treasurer of such societies. This statement shall be filed annually, on or before the tenth day of January, in the office of the secretary of the Board of Agriculture. (See Public Statutes, chapter 114, section 2; also Acts of 1891, chapter 124.)

Mortgage or sale of real estate.

RULE 3. No incorporated agricultural society which has received or which may receive State bounty shall sell or mortgage the whole or any part of its real estate without an affirmative vote of two-thirds of the members of such society present and voting at a meeting duly called for that purpose; and the vote must afterward be approved by the State Board of Agriculture, after due notice to parties interested and a hearing thereon. (See Acts of 1890, chapter 274, section 1.)

Amount of bounty.

RULE 4. "The amount of money to which a society is entitled for any year shall be ascertained by the certificate last filed by it with the secretary of the Board; but a society shall not receive bounty in any year if the State Board of Agriculture, having first given such society full opportunity to be heard in relation to its financial affairs and general management, so determines by a two-thirds vote of the whole number of its members present at its annual meeting." And, in the event of the Board withholding the bounty from any society, the secretary of the Board must notify the Treasurer of the Commonwealth on or before the first day of September in such year. (See Public Statutes, chapter 114, section 3.)

Premium returns.

RULE 5. Each society shall annually make a return of its doings, "embracing a statement of the expenditure of *all money*, specifying the nature of the encouragement proposed by the society, the objects for which its premiums have been offered, *and the persons to whom they have been awarded*," together with a statement of which premiums have been paid from the State bounty. This statement shall be signed by its president and secretary, and filed with the secretary of the State Board of Agriculture on or before the tenth day of January. (See Public Statutes, chapter 114, section 5.)

Residents of State.

RULE 6. No part of the State bounty shall be paid in premiums to any persons who are not residents of the State.

RULE 7. All moneys paid in premiums to parties not residents of the State shall not be considered in predicating the amount of State bounty the society shall receive.

Scale of points.

Rule 8. Each society drawing bounty shall adopt the scale of points established by the Board of Agriculture in the awarding of premiums on live stock, vegetables, and fruits, to the end that there shall be uniform modes throughout the State. (See Public Statutes, chapter 114, section 16.)

Experts.

Rule 9. In judging all live stock, fruit, and vegetables, each society shall employ an expert or experts. These expert judges shall be instructed to appoint a time for listening to appeals and of giving the reasons for their decisions, if called for; but their decisions shall be final.

Grade or native bulls.

Rule 10. No society receiving a bounty of the State shall bestow any premiums or gratuities on grade or native bulls.

Live stock.

Rule 11. All live stock entered for exhibition shall be kept on the grounds until 3 o'clock in the afternoon of the first day.

Colors of premiums.

Rule 12. All societies receiving the bounty of the State shall be required, immediately after the awards of the several committees are made, to cause to be attached to each animal or article to which a first premium has been awarded a blue ribbon or card, with "First Premium" printed thereon; and to each animal or article to which a second premium has been awarded, a red ribbon or card, with "Second Premium" printed thereon; and to each animal or article to which a third premium has been awarded, a white ribbon or card, with "Third Premium" printed thereon, — to the end that a uniform practice may be followed by all the societies.

Drawing tests.

Rule 13. In drawing tests of cattle, horses or mules or in speed tests of horses, no excessive whipping or other abuse of animals shall be allowed. In drawing tests with the drag each team shall not be allowed to exceed three trials and not to exceed five minutes, after the team is properly hitched to the load, shall be allowed for any one trial.

Statement to accompany entries.

Rule 14. In awarding prizes for bread, butter and cheese, cooked, preserved and canned fruits and vegetables, field crops, and experiments, a written statement must accompany each entry, setting forth how each was prepared, the crop raised, or the experiment conducted; in short, giving a brief history of the same.

Weight of crops.

RULE 15. The following is established as the standard by which crops shall be estimated by weight by the several societies: Indian corn, in the cob as taken from the field, shall be rated as 80 pounds to a bushel; a bushel of Indian corn, shelled and dry, shall be 56 pounds; a bushel of rye, 56 pounds; a bushel of barley, 48 pounds; a bushel of buckwheat, 48 pounds; a bushel of oats, 32 pounds; a bushel of wheat, 60 pounds; a bushel of potatoes, 60 pounds; a bushel of carrots, 55 pounds; a bushel of onions, 52 pounds; a bushel of sugar beets, 60 pounds; a bushel of mangel-wurzels, 60 pounds; a bushel of ruta-bagas, 60 pounds; a bushel of parsnips, 45 pounds; a bushel of common or English turnips, 50 pounds; a bushel of white beans, 60 pounds; a bushel of peas, 60 pounds.

Farmers' institutes.

RULE 16. Each agricultural society receiving the bounty of the Commonwealth shall hold within its limits not less than three farmers' institutes each calendar year; and the Board shall render all the assistance in its power to make such institutes interesting and profitable. The secretary of the Board shall also attend these institutes, so far as is compatible with the duties of his office; and he shall provide lectures for the institutes, so far as the appropriation for this object will warrant. But he shall not be authorized to pay more than one lecturer for each institute. Each society may hold more than three institutes, if it so desires; and the secretary of each society shall be required to certify to the holding of each institute, on blanks furnished by the secretary of the Board.

List of members.

RULE 17. Each society must print in its transactions the names of the officers for each year succeeding their election, and once in three years the list of its members, with their post-office addresses.

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## RECOMMENDATIONS OF THE BOARD.

State premiums.

1. The societies of the State drawing bounty are hereby notified that it will be permissible for them to offer a part or all of the State bounty as special or State premiums, to be awarded on cards bearing the coat-of-arms of the State, which the secretary of the Board will furnish on request; and it is recommended and hoped that the societies, so far as they are able, will try this plan with some or all of the classes to which the State bounty is applicable.

Live stock.

2. The Board recommends that all live stock entered for exhibition be kept on the grounds through the entire exhibition.

Nomenclature of fruits.

3. The Board recommends that the various societies in the nomenclature of fruits at their exhibitions and in their publications conform to the catalogue of the American Pomological Society.

Farmers' institutes.

4. The Board recommends and earnestly requests that each agricultural society, at its annual meeting, fix the dates at which it will hold the several institutes required under Rule 16, and the subjects it desires to have discussed, and as soon as possible notify the secretary of the Board if it desires assistance in the procuring of lecturers.

## Agricultural Exhibitions.

Dates for holding fairs.

The time for holding the fairs of the agricultural societies receiving bounty from the State of Massachusetts shall be as follows: —

Amesbury and Salisbury, fourth Tuesday after the first Monday in September.

Attleborough, fifth Tuesday after the first Monday in September.

Barnstable County, second Tuesday after the first Monday in September.

Berkshire, second Tuesday after the first Monday in September.

Blackstone Valley, fourth Tuesday after the first Monday in September.

Bristol County, fourth Tuesday after the first Monday in September.

Deerfield Valley, second Thursday after the first Monday in Spetember.

Eastern Hampden, third Tuesday after the first Monday in September.

Essex, third Tuesday after the first Monday in September.

Franklin County, third Thursday after the first Monday in September.

Hampden, third Thursday after the first Monday in September.

Hampshire, fourth Tuesday after the first Monday in September.

Hampshire, Franklin and Hampden, third Tuesday after the first Monday in September.

Highland, first Wednesday after the first Monday in September.

Hillside, fourth Tuesday after the first Monday in September.

Hingham, fourth Tuesday after the first Monday in September.
Hoosac Valley, third Tuesday after the first Monday in September.
Housatonic, fourth Wednesday after the first Monday in September.
Marshfield, second Wednesday after the first Monday in September.
Martha's Vineyard, third Tuesday after the first Monday in September.
Massachusetts Horticultural, fifth Tuesday after the first Monday in September.
Middlesex North, second Thursday after the first Monday in September.
Middlesex South, second Tuesday after the first Monday in September.
Nantucket, first Wednesday after the first Monday in September.
Oxford, third Tuesday after the first Monday in September.
Plymouth County, third Wednesday after the first Monday in September.
Spencer, third Thursday after the first Monday in September.
Union, second Wednesday after the first Monday in September.
Weymouth, fourth Thursday after the first Monday in September.
Worcester, first Tuesday after the first Monday in September.
Worcester East, second Thursday after the first Monday in September.
Worcester North, third Tuesday after the first Monday in September.
Worcester North-west, fifth Tuesday after the first Monday in September.
Worcester South, second Thursday after the first Monday in September.
Worcester County West, fourth Thursday after the first Monday in September.

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# ELEVENTH ANNUAL REPORT

OF THE

# BOARD OF CONTROL

OF THE

# STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1893.

BOSTON:
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1894.

# Commonwealth of Massachusetts.

BOSTON, Jan. 10, 1894.

*To the Honorable Senate and House of Representatives.*

In accordance with chapter 212 of the Acts of 1882 I have the honor to present the Eleventh Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,
*Secretary.*

# MASSACHUSETTS STATE

# AGRICULTURAL EXPERIMENT STATION,

## AMHERST, MASS.

### BOARD OF CONTROL, 1893.

His Excellency William E. Russell,
*Governor of the Commonwealth, President ex officio.*

W. H. Bowker of Boston, . . . . . Term expires, 1895.
C. L. Hartshorn of Worcester, . . . . Term expires, 1894.
*Appointed by the State Board of Agriculture.*

J. H. Demond of Northampton, . . . . Term expires, 1896.
E. D. Howe of Marlborough, . . . . Term expires, 1896.
*Appointed by the Board of Trustees of the Massachusetts Agricultural College.*

F. H. Appleton of Peabody, . . . . Term expires, 1894.
*Appointed by the Massachusetts Society for Promoting Agriculture.*

W. H. Porter of Agawam, . . . . . Term expires, 1894.
*Appointed by the Massachusetts State Grange.*

Wm. C. Strong of Newton Highlands, . . Term expires, 1894.
*Appointed by the Massachusetts Horticultural Society.*

H. H. Goodell, A.M., LL.D., Amherst,
*President of the Massachusetts Agricultural College.*

C. A. Goessmann, Ph.D., LL.D., Amherst,
*Director of the Station.*

Wm. R. Sessions, Hampden,
*Secretary of the State Board of Agriculture.*

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H. H. Goodell, Amherst,
*Vice-President.*

Wm. R. Sessions, Hampden,
*Secretary and Auditor.*

C. A. Goessmann, Amherst,
*Treasurer pro tem.*

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C. A. Goessmann, Ph.D., LL.D., *Director and Chemist*, . . Amherst.

J. B. Lindsey, Ph.D., *Associate Chemist* (*Feeding Department*), . Amherst.

Assistants.

| | |
|---|---|
| C. S. Crocker, B.S., . | *General and Analytical Chemistry.* |
| H. D. Haskins, B.S., . | “ “ “ |
| C. H. Jones, B.S., . . | “ “ “ |
| F. L. Arnold, B.S., . | “ “ “ |
| C. H. Johnson, B.S., . | *Assistant Chemist and Feeding Department.* |
| E. B. Holland, B.S., . | “ “ “ “ |
| R. H. Smith, B.S., . . | *Assistant Chemist and Field Experiments.* |
| L. E. Goessmann, . . | *Assistant Chemist and Clerk.* |
| David Wentzell, . . | *Farmer.* |

# ELEVENTH ANNUAL REPORT OF THE DIRECTOR

OF THE

# MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

*To the Honorable Board of Control.*

Gentlemen: — The work carried on at the State Agricultural Experiment Station during the past year compares favorably with that of the preceding year. The various lines of investigation presented for your consideration and indorsement at the different meetings of the Board have been followed up to the full extent of the resources at my disposal. The results obtained in some cases cannot fail to be of more than ordinary interest to the farmers of our State, while in others more time is needed for observation to draw reliable conclusions from the results thus far secured.

The recent additions and improvements in the outfit of the feeding department have aided materially in the investigation of more intricate questions of animal nutrition. The economical production of milk, beef, mutton, veal and pork has received serious attention. New concentrated feed stuffs, as well as coarse fodder articles raised upon the station grounds and new to our section of the country, have been practically tested, to ascertain their relative economical value as compared with current modes of feeding. The digestibility of various concentrated feed stuffs has been carefully tested by Dr. J. B. Lindsey in a series of trials with sheep. Experiments for ascertaining the relative economy of feeding skim-milk to young pigs and calves raised for the meat market have been instituted. A detailed account of these experiments will be found farther on under the following headings: —

## PART I.

### ON FEEDING EXPERIMENTS.

I. Feeding experiments with milch cows (two).
  1. General feeding experiments with milch cows: —
    Grain feed: Buffalo gluten feed, wheat bran and cotton-seed meal.
    Coarse feed: English hay, corn stover, and corn and soja-bean ensilage.
  2. Summer feeding experiments with milch cows: —
    Grain feed: Buffalo gluten feed, new-process linseed meal, wheat bran and cotton-seed meal.
    Coarse feed: rowen, green fodder corn and green vetch and oats.
  3. Creamery record of the station for 1892 and 1893.

II. Feeding experiments with steers.
III. Feeding experiments with lambs.
IV. Feeding experiments with pigs (two).
V. Feeding experiments with calves.
VI. Digestion experiments with sheep.
VII. Feeding experiments with horses.

The past season was not quite as favorable for the conducting of field experiments as some preceding years have been. A serious drought at the close of the growing period affected the results in a number of cases. Many of the results obtained may, however, be considered satisfactory. The following lines of investigation have been carried on in the field.

## PART II.

### ON FIELD EXPERIMENTS.

1. Field experiments to ascertain the effect of the exclusion of every form of nitrogen-containing manurial matter from the fertilizer applied for the production of a grain crop (oats) on its yield per acre (Field A).
2. Field experiments with prominent varieties of grasses and grass mixtures under fairly corresponding circumstances and with different varieties on potatoes (Field B).
3. Field experiments regarding the effect of different combinations of commercial fertilizers on the yield of some prominent garden crops (Field C).
4. Observations regarding the adaptation of a variety of more or less reputed fodder plants new to our section of the country (Field D).

5. Field experiments with different commercial phosphates, to study the economy of using the cheaper natural phosphates or the more costly acidulated phosphates (Field F).
6. Field experiments to show the effect of barn-yard manure on the yield of corn (Field G).
7. Field experiments to determine the effect of various fertilizer mixtures on leguminous and grain crops (East Field).
8. Observations on permanent grass lands, — meadows.
9. Report on general farm work.
10. On special fertilization with reference to some prominent industrial crops, fruits and garden vegetables.

The recently increased facilities for chemical analysis have been tested to their full capacity, as may be seen from the following enumeration of examinations called for: —

| | |
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| Fertilizers, for station, | 24 |
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| Milk, sent on, | 26 |
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| Skim-milk, | 24 |
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| Miscellaneous, | 32 |

The entire work carried on in the chemical department will be found in subsequent pages under the following heads: —

## PART III.

### SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on commercial fertilizers: —
   1. General introduction.
   2. State laws for the regulation of the trade in commercial fertilizers.
   3. List of licensed manufacturers and dealers from May 1, 1893, to May 1, 1894 (52).
   4. Analyses of licensed fertilizers (214).
   5. Analyses of commercial fertilizers and manurial substances sent on for examination (169).
   6. Miscellaneous analyses (7).
   7. Miscellaneous fodder analyses (45).

II. Analyses of milk sent on for examination (26).
III. Analyses of water sent on for examination (93).
IV. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.
V. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.
VI. Table of the digestibility of American feed stuffs.

The meteorological observations for local purposes have been continued, and the results reported to the authorities in Boston and Washington. The periodical publications of the work accomplished at the station have been continued, seven bulletins having been issued during the year, treating mainly of analyses of fertilizers, feed stuffs, etc. The interest in these publications has manifested itself by a steady increase of applications from within the State as well as other parts of the country.

The general condition of some of the buildings of the experiment station is such that in the interest of good economy serious attention for more extensive repairs seems advisable at this time. As the existing financial resources do not warrant the expenditures in that direction, I recommend the application for suitable appropriation by the State Legislature to meet these wants.

I feel it my pleasant duty to express to you my particular satisfaction for the assistance I have received from all parties engaged with me in the work accomplished during the past year. Thanking you for your kind support in the performance of the duties assigned me, I am,

Yours very respectfully,

C. A. GOESSMANN,

*Director of the Massachusetts State Agricultural Experiment Station.*

# PART I.

# FEEDING EXPERIMENTS.

BY J. B. LINDSEY.

I. Feeding Experiments with Milch Cows (two).
II. Feeding Experiments with Steers.
III. Feeding Experiments with Lambs.
IV. Feeding Experiments with Pigs (two).
V. Feeding Experiments with Calves.
VI. Digestion Experiments with Sheep.
VII. Feeding Experiments with Horses.

## GENERAL INTRODUCTION.

The feeding experiments described in this report have been conducted with a view to answering many of the practical questions asked by the farmers of Massachusetts. Several of them are a continuation of those published in previous reports, while others have been started to answer questions of importance to the farming community. They are divided as follows: —

### *I. Feeding Experiments with Milch Cows.*

The principal objects of these experiments have been: —

1. To ascertain the comparative value of different kinds of *coarse fodders* upon the economical production of milk and cream.

2. To notice the effects of these foods, if any, upon the composition of the milk and cream.

Many other facts are also brought out in the experiment, as, for example, the number of quarts of milk required to produce a space of cream, etc.

The general object of all the experiments with milch cows has been to find those methods of feeding best suited to produce milk and cream at the minimum cost, and to do this by raising a greater variety of coarse fodder articles upon the farm, and supplementing these fodders with concentrated feed stuffs.

### *II. Feeding Experiments with Steers.*

These experiments have been in progress for several years, with these objects in view: —

1. To ascertain those fodder rations that would produce the greatest growth for the least outlay of money.

2. To find out what it actually costs to produce beef in Massachusetts.

3. To compare the relative merits of soiling *vs.* pasture for growing stock during the summer months.

### *III. Feeding Experiments with Lambs (Winter).*

The objects sought have been: —

1. To find the cost of producing live weight under a rational system of feeding.

2. To find out if ensilage could be substituted to a considerable extent for rowen in the coarse fodder rations.

### *IV. Feeding Experiments with Pigs.*

Objects: —

1. To ascertain the value of Buffalo gluten feed and corn meal when fed in connection with skim-milk.

2. The cost of producing pork.

### *V. Feeding Experiments with Calves.*

Objects: —

1. To ascertain whether it is more profitable to feed skim-milk to growing calves or to pigs.

2. To find the rate of growth when calves are fed on skim-milk alone, and when fed on skim-milk and grain.

In all the five experiments thus far mentioned, especial attention is called to the value of the manure produced in connection with a rational system of general farm management. Upon the character of the food fed depends not only the quantity of milk, beef, pork or mutton produced, but also the value of the manure obtained.

### *VI. Digestion Experiments with Sheep.*

The object of these experiments has been to inquire into the digestibility of English mixed hay and of the new concentrated feed stuffs, such as Buffalo gluten feed, the new and old process linseed meals, etc.

### *VII. Feeding Experiments with Horses.*

This section contains facts in relation to the feeding of four horses at the station during several years past (1888-93).

Farmers are especially requested to address the station if questions arise relating to the experiments herein described, or if any information is desired concerning any problem in stock feeding. Any information at the command of the station will be cheerfully given.

J. B. LINDSEY.

# I.

# FEEDING EXPERIMENTS WITH MILCH COWS (TWO).

## 1. General Feeding Experiments with Milch Cows.

*October, 1892, to July, 1893.*

[Grain feed: Buffalo gluten feed, wheat bran and cotton-seed meal; coarse feed: English hay, corn stover and corn and soja-bean ensilage.]

### *Objects of the Experiment.*

1. To study the comparative feeding effects of English hay, corn stover and corn and soja-bean ensilage upon the cost, quantity and quality of the milk produced.

2. The comparative feeding value of rowen *vs.* hay of peas and oats.

Attention is also called to the value of the manurial ingredients in the feed consumed, and to the value of the manure produced by the different rations fed; also the quality of the milk produced during the different feeding periods.

*History of Cows.*

| NAME OF COW. | BREED. | Age (Years). | LAST CALF DROPPED. | Daily Yield of Milk at Beginning of Trial (Quarts). | Number of Months on Trial. |
|---|---|---|---|---|---|
| May, . . | Native, . . . . | 6-7 | Jan. 15, 1892, | 6–7 | 9 |
| Gem, . . | Grade Shorthorn, . | 5 | Dec. 6, 1891, | 11–12 | 10 |
| Lucy, . . | Grade Ayrshire, . | 6 | June 2, 1891, | 8–9 | 17 |
| Florence, . | Grade Shorthorn, . | 7 | May 13, 1892, | 10–11 | 5 |
| Viola, . . | Native, . . . . | (?) | Feb. 10, 1892, | 5–6 | 7 |
| Anna, . . | Native, . . . . | (?) | Jan. 26, 1892, | 5–6 | 8 |
| Stella, . . | Grade Durham, . | 11 | Jan. 5, 1893, | 16–17 | – |
| Jennie, . | Grade Jersey, . . | 4 | Dec. 25, 1892, | 10–11 | – |
| Julia, . . | Native, . . . . | 9 | Jan. 18, 1893, | 12–13 | – |
| Nora, . . | Grade Ayrshire, . | 5 | Mar. 25, 1893, | – | – |

As will be seen from the above record, these cows are grades of various descriptions and of different milking periods. They probably represent average cows of the various herds kept by farmers in this section of the State.

It will be observed that only two of the cows, viz., Gem and Florence, were retained during the entire experiment, several having been dropped, owing to a too advanced stage of milking, and new milch cows put in their places. The records of all the cows on trial are, however, presented, as they furnish data from which to judge of the comparative feeding effects of the several varieties of fodder.

### *Description of Fodder Articles.*

The grain feed remained constant throughout the entire experiment, and consisted of Buffalo gluten feed, wheat bran and cotton-seed meal. The chemical and mechanical condition was good.

The coarse feed consisted of good hay of mixed grasses, rowen (second cut of grass lands), well-cured hay of peas and oats, corn stover, corn and soja-bean ensilage and globe mangolds.

The ensilage was made from "Pride of the North" corn and a late variety of soja bean, cut up into pieces several inches in length. The corn was cut for ensilage when the kernels had begun to glaze. The soja bean was a late variety which failed to blossom. When cut it measured three and one-half feet in height.

Silo No. 1 contained equal weight parts of corn and soja bean, while silo No. 2 contained two parts of soja bean to one part of corn. These ensilages are called respectively corn and soja-bean ensilage and soja-bean and corn ensilage. The silos were filled rapidly, and treated as described in previous reports. Silo No. 1 was much larger, and contained several times as much ensilage as No. 2.

The corn stover was obtained from the same variety of corn as that put into the silo, and is the field-cured plant remaining after the fully matured ears have been removed. It was cut into short lengths before being fed. The hay of peas and oats was the portion that remained over from the summer green feeding, and was cut when in late blossom and dried.

The following tables contain the analyses of the various grains and coarse fodders, together with their fertilizing value obtainable after they have passed through the animal, *i. e.*, in the manure.

### *Analyses of Fine Feed used.*

| FODDER ANALYSES. | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. |
|---|---|---|---|
| Moisture at 100° C., | 10.35 | 8.28 | 7.00 |
| Dry matter, | 89.65 | 91.72 | 93.00 |
| | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | |
| Crude ash, | 7.39 | 0.91 | 7.45 |
| " cellulose, | 11.60 | 7.78 | 6.63 |
| " fat, | 5.72 | 13.61 | 12.20 |
| " protein, | 17.78 | 26.03 | 44.33 |
| Non-nitrogenous extract matter, | 57.51 | 51.67 | 29.39 |
| | 100.00 | 100.00 | 100.00 |

### *Fertilizing Constituents.*

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

| FERTILIZER ANALYSES. | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. |
|---|---|---|---|
| Moisture, | 10.35 | 8.28 | 7.00 |
| Nitrogen, | 2.45 | 3.82 | 6.59 |
| Phosphoric acid, | 2.85 | 0.46 | 2.33 |
| Potassium oxide, | 1.63 | 0.10 | 1.72 |
| Valuation per 2,000 pounds, | $11 95 | $12 06 | $23 88 |
| Manurial value obtainable, | 9 56 | 9 65 | 19 10 |

### *Analyses of Coarse Fodder Articles used.*

| FODDER ANALYSES. | Hay. | Rowen. | Hay of Peas and Oats. | Corn Stover. | Corn and Soja-bean Ensilage.* | Soja-bean and Corn Ensilage.† | Globe Mangolds. |
|---|---|---|---|---|---|---|---|
| Moisture at 100° C., | 9.00 | 11.31 | 12.30 | 14.66 | 77 77 | 80.33 | 88.51 |
| Dry matter, | 91.00 | 88.69 | 87.70 | 85.34 | 22.23 | 19.67 | 11.49 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | | | |
| Crude ash, | 6.64 | 6.48 | 6.90 | 5.49 | 9.48 | 11.91 | 12 88 |
| " cellulose, | 34.82 | 29.98 | 26.66 | 37.57 | 26.63 | 29.00 | 9.98 |
| " fat, | 3.18 | 4.23 | 2.29 | 1.82 | 3.75 | 3.02 | 1.14 |
| " protein, | 10.41 | 12.11 | 16.01 | 4.00 | 7.91 | 8.41 | 7.04 |
| Non-nitrogenous extract matter, | 44 95 | 47.20 | 48.14 | 51.12 | 52 23 | 47.66 | 68.96 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 00 | 100.00 |

### *Fertilizing Constituents.*

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

| FERTILIZER ANALYSES. | Hay. | Rowen. | Hay of Peas and Oats. | Corn Stover. | Corn and Soja-bean Ensilage.* | Soja-bean and Corn Ensilage.† | Globe Mangolds. |
|---|---|---|---|---|---|---|---|
| Moisture, | 9.00 | 11.30 | 12.30 | 14.66 | 77.77 | 80.33 | 88.51 |
| Nitrogen, | 1.52 | 1.72 | 2.24 | 0.55 | 0.32 | 0.27 | 0.13 |
| Phosphoric acid, | 0.35 | 0.46 | 0.65 | 0.23 | 0.12 | 0.12 | 0.10 |
| Potassium oxide, | 1.54 | 1.97 | 2.10 | 1.84 | 0.48 | 0.48 | 0.47 |
| Valuation per 2,000 pounds, | $6 32 | $6 56 | $9 32 | $3 55 | $1 52 | $1 37 | $0 92 |
| Manurial value obtainable, | 5 06 | 5 25 | 7 46 | 2 84 | 1 22 | 1 10 | 0 74 |

* Equal parts by weight. † Two parts soja bean to one part corn.

### *Mode of Feeding.*

The entire experiment is divided into two parts: Part 1 includes hay, hay and roots, corn stover, "corn and soja-bean ensilage," and "soja-bean and corn ensilage." It covers nearly eight months. The feeding periods vary in length from several weeks to several months in case of the corn and soja-bean ensilage. Part 2 has only two feeding periods, and extends over but one month of time.

The grain ration remained constant during the entire experiment, and consisted of three pounds each of wheat bran, Buffalo gluten feed and cotton-seed meal. One-half the grain was fed at the time of milking in the morning, together with one-half of the coarse fodder; and the other half, together with the remainder of the coarse fodder, at the time of milking in the afternoon, about five o'clock.

The animals were watered twice each day, about two hours after feeding.

The amount of coarse fodder fed depended upon the individual appetite of the different animals. Hay constituted the entire coarse feed in the first feeding period, and amounted to fifteen pounds per day. In the second period fifteen pounds of globe mangolds were added. The corn stover consumed in the third period amounted to from twelve to fourteen pounds daily. When first fed the animals consumed somewhat more, but the amount gradually decreased to twelve to fourteen pounds, which can be regarded as the average daily consumption. During the fourth and fifth periods the hay feed was limited to four pounds daily, while the ensilage was fed *ad libitum.* This generally amounted to from forty to sixty pounds per day, with fifty pounds as a fair average. During the sixth period the hay of peas and oats consumed varied from fourteen to sixteen pounds daily, and the rowen in the seventh period, from sixteen to eighteen pounds per day.

For more details see the record of each cow.

*Local Market Cost, per Ton, of the Various Articles of Fodder.*

| | |
|---|---|
| Wheat bran, | $19 00 |
| Buffalo gluten feed, | 20 00 |
| Cotton-seed meal, | 28 00 |
| Hay, | 15 00 |
| Rowen, | 15 00 |
| Hay of peas and oats, | 15 00 |
| Corn stover, | 5 00 |
| Corn and soja-bean ensilage, | 2 75 |
| Soja-bean and corn ensilage, | 2 75 |
| Globe mangolds, | 4 00 |

The commercial value of the various fodder rations about to be described is based upon the above-stated market cost.

*Average Composition of the Daily Fodder Rations used during the Seven Successive Feeding Periods (1892–1893).*

3 pounds wheat bran equal 4 quarts.
3 pounds Buffalo gluten feed equal 3 quarts.
3 pounds cotton-seed meal equal 2 quarts.

I.

*October 18 to November 9.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Cotton-seed meal, | 3 " |
| Hay, | 15 " |
| Nutritive ratio, | 1:4.5 |
| Total cost, | 21.3 cts. |
| Manurial value obtainable, | 9.54 " |
| Net cost, | 11.76 " |

II.

*November 14 to December 3.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Cotton-seed meal, | 3 " |
| Hay, | 15 " |
| Globe mangolds, | 15 " |
| Nutritive ratio, | 1:4.9 |
| Total cost, | 24.3 cts. |
| Manurial value obtainable, | 10.10 " |
| Net cost, | 14.20 " |

III.

*December 12 to January 9.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Cotton-seed meal, | 3 " |
| Corn stover, | 15 " |
| Nutritive ratio, | 1:4.8 |
| Total cost, | 13.85 cts. |
| Manurial value obtainable, | 7.88 " |
| Net cost, | 5.97 " |

IV.

*January 18 to April 4.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Cotton-seed meal, | 3 " |
| Hay, | 4 " |
| Corn and soja-bean ensilage, | 50 " |
| Nutritive ratio, | 1:4.9 |
| Total cost, | 19.90 cts. |
| Manurial value obtainable, | 9.81 " |
| Net cost, | 10.09 " |

V.

*May 11 to May 26.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Cotton-seed meal, | 3 " |
| Hay, | 4 " |
| Soja-bean and corn ensilage, | 50 " |
| Nutritive ratio, | 1:4.8 |
| Total cost, | 19.90 cts. |
| Manurial value obtainable, | 9.51 " |
| Net cost, | 10.39 " |

VI.

*June 8 to June 21.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Cotton-seed meal, | 3 " |
| Hay of peas and oats, | 16 " |
| Nutritive ratio, | 1:3.77 |
| Total cost, | 22.05 cts. |
| Manurial value obtainable, | 10.36 " |
| Net cost, | 11.69 " |

*Average Composition of the Daily Fodder Rations* — Concluded.

VII.

*June 27 to July 6.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Cotton-seed meal, | 3 " |
| Rowen, | 18 " |
| Nutritive ratio, | 1:4.51. |
| Total cost, | 23.55 cts. |
| Manurial value obtainable, | 10.48 " |
| Net cost, | 13.07 " |

*Summary of Cost of the Average Daily Fodder Rations.*
[Cents.]

| | | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| I. | Grain and hay, | 21.30 | 9.54 | 11.76 |
| II. | Grain, hay and mangolds, | 24.30 | 10.10 | 14.20 |
| III. | Grain and corn stover, | 13.85 | 7.88 | 5.97 |
| IV. | Grain, hay and ensilage, | 19.90 | 9.81 | 10.09 |
| V. | Grain, hay and ensilage, | 19.90 | 9.51 | 10.39 |
| VI. | Grain and hay of peas and oats, | 22.05 | 10.36 | 11.69 |
| VII. | Grain and rowen, | 23.55 | 10.48 | 13.07 |

The *total cost* of a fodder ration is the sum of the market costs of the different articles consumed per day. The *manurial value obtainable* is the value of the nitrogen, phosphoric acid and potash of the ration fed that will be found in the manure. In case of milch cows this amounts on an average to 80 per cent. of the fertilizing ingredients contained in the feed. The other 20 per cent. goes into the milk or flesh of the animal. The value of the nitrogen, phosphoric acid and potash thus excreted is based upon the retail cost of these articles in the open markets. When the experiment was in operation this amounted to 15 cents per pound for nitrogen, 5½ cents per pound for phosphoric acid and 4½ cents per pound for potash. The *net cost* of a ration is that cost remaining after the value of the manure has been deducted from the total cost. It is to be observed that the value of the manure, *i.e.*, its content of nitrogen, phosphoric acid and potash, depends entirely upon the character of the fodder articles fed. Thus, if the feed consists of corn meal and hay, each of which articles have an obtainable manurial value of about $5 per ton, the value of the manure will be considerably inferior to one where cotton-seed meal with an obtainable manurial value of about $20 per ton or wheat bran with an obtainable manurial value of $10 per ton are fed.

All the concentrated feed stuffs, such as linseed meal, cotton-seed meal, gluten meal, gluten feed and wheat bran, have a very high percentage of nitrogen, which greatly increases the value of the manure produced by the animal.

*Quantity and Cost of Milk produced per Day.*

| FEEDING PERIODS. | MAY. | | GEM. | | LUCY. | | VIOLA. | | ANNA. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity Daily. | Cost per Quart. | Quantity Daily. | Cost per Quart. | Quantity Daily. | Cost per Quart. | Quantity Daily. | Cost per Quart. | Quantity Daily. | Cost per Quart. |
| | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. |
| *Part 1.* | | | | | | | | | | |
| I. Grain and hay, . . . | 6.34 | 3.36 | 11.24 | 1.89 | 8.45 | 2.52 | 5.82 | 3.65 | 5.80 | 3.67 |
| II. Grain, hay and mangolds, | 6.47 | 3.76 | 11.93 | 2.04 | 8.84 | 2.75 | 5.23 | 4.61 | 5.72 | *3.60 |
| III. Grain and corn stover, . | 4.94 | 2.71 | 9.26 | 1.45 | 6.69 | 1.95 | 3.74 | 3.78 | 4.75 | 2.73 |
| IV. Grain, hay and ensilage, . | – | – | 12.21 | 1.55 | 7.30 | 2.27 | – | – | – | – |
| V. Grain, hay and ensilage, . | – | – | 11.77 | 1.71 | – | – | – | – | – | – |
| *Part 2.* | | | | | | | | | | |
| VI. Grain and peas and oats, | – | – | 10.32 | 2.04 | – | – | – | – | – | – |
| VII. Grain and rowen, . . | – | – | 11.03 | 2.07 | – | – | – | – | – | – |
| Average, . . . | 5.92 | 3.28 | 11.11 | 1.82 | 7.82 | 2.37 | 4.98 | 4.01 | 5.42 | 3.33 |

* Cow consumed five pounds less hay per day during this period.

*Quantity and Cost of Milk produced per Day* — Continued.

| FEEDING PERIODS. | FLORENCE. | | JULIA. | | JENNIE. | | NORA. | |
|---|---|---|---|---|---|---|---|---|
| | Quantity Daily. | Cost per Quart. | Quantity Daily. | Cost per Quart. | Quantity Daily. | Cost per Quart. | Quantity Daily. | Cost per Quart. |
| | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. |
| *Part 1.* | | | | | | | | |
| I. Grain and hay, . . . | 10.46 | 2.04 | - | - | - | - | - | - |
| II. Grain, hay and mangolds, . | 10.58 | 2.29 | - | - | - | - | - | - |
| III. Grain and corn stover, . | 7.12 | 1.87 | - | - | - | - | - | - |
| IV. Grain, hay and ensilage, . | 9.31 | 2.14 | 12.85 | 1.52 | 10.86 | 1.72 | - | - |
| V. Grain, hay and ensilage, . | 8.24 | 2.43 | 11.50 | 1.73 | 9.50 | 2.02 | 11.45 | 1.73 |
| *Part 2.* | | | | | | | | |
| VI. Grain and peas and oats, . | 7.20 | 3.00 | - | - | 8.70 | 2.42 | 10.48 | 1.94 |
| VII. Grain and rowen, . . | 7.52 | 3.13 | 9.30 | 2.37 | 8.19 | 2.58 | 10.60 | 2 08 |
| Average, . . . . | 8.63 | 2.41 | 11.22 | 1.87 | 9.31 | 2.18 | 10.84 | 1.92 |

### *Comments on the Above Results.*

Remembering that during the entire experiment the grain ration remained the same, and that the quantity of coarse fodders fed was in all cases governed by the individual appetite of the animal, the following points are worthy of notice: —

1. That when the roots were added to the hay ration the flow of milk in four cases out of six increased, in one case remained constant and in one case slightly decreased. The increased yield, however, was not sufficient to pay for the extra cost of the roots, and the total cost of the milk per quart was noticeably increased in this period.

2. The grain and hay ration produced a comparatively fair yield, but the average cost of production per quart in the case of three cows whose record extends through the three periods was above that for the corn stover and corn and soja-bean ensilage rations. The cost per quart when hay was fed as the coarse fodder was 2.15 cents, with corn stover but 1.76 cents and with ensilage 1.99 cents.

3. The yield of milk decreased on an average 25 per cent. during the corn-stover period; but because of the low

market value of this fodder the average cost of producing one quart of milk, in case of three cows, was lowest in this period, namely, 1.76 cents.

4. In feeding period IV. (corn and soja-bean ensilage), where cows Gem, Lucy and Florence are considered, it will be observed that the ensilage caused a marked increase in the yield of milk from Gem, and not a very great decrease in the case of the other two cows. These results, together with the fact that the period lasted seventy-five days, during which time the cows would naturally shrink some in their yield, indicates that the corn and soja-bean ensilage was instrumental in stimulating the flow of milk. This period produced milk, in case of five cows whose average yield was 10.5 quarts per day, at 1.84 cents per quart, which may be considered fairly low.

5. In comparing the merits of rowen and the hay of peas and oats, it will be observed that there is no great difference in the results. The yield of milk was slightly increased by the rowen over the peas and oats, but rather more rowen was consumed, making the cost per quart of milk a trifle higher. It can be stated, however, that hay of well-cured peas and oats compares very favorably with a good quality of rowen for milk production.

6. That the cost of milk per quart depends upon the absolute yield is also worthy of notice. It is noticeable that when the cows yield but 4 to 5 quarts of milk per day the total cost of this milk is 3½ to 4 cents per quart; and when 6 quarts are produced the cost is about 3 cents per quart. This fact has been previously emphasized in the reports of the station, namely, that a cow ceases to be profitable when she yields but 6 quarts or less per day. If the farmer, therefore, would make milk production profitable it is of the utmost importance that he should select cows that are capable of giving large and continuous yields of milk. A herd of cows in which the average yield is but 7 to 8 quarts cannot be a very profitable one.

*Quality of Milk produced.*

| Feeding Periods. | Rations. | May. | | Gem. | | Lucy. | | Viola. | | Anna. | | Florence. | | Jennie. | | Julia. | | Nora. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. |
| | *Part 1.* | | | | | | | | | | | | | | | | | | |
| I.<br>22 days. | Grain and hay, | 14.00 | 3.50 | 13.76 | 3.90 | 14.57 | 4.05 | 13.89 | 3.90 | 11.76 | 2.70 | 14.24 | 4.65 | - | - | - | - | - | - |
| | Grain and hay, | 13.72 | 3.60 | 13.50 | 4.05 | 13.27 | 4.20 | 14.80 | 3.80 | 12.03 | 2.60 | 14.22 | 4.25 | - | - | - | - | - | - |
| | Average, | **13.86** | **3.55** | **13.63** | **3.97** | **13.92** | **4.12** | **14.34** | **3.85** | **11.90** | **2.65** | **14.23** | **4.45** | - | - | - | - | - | - |
| II.<br>19 days. | Grain, hay and mangolds, | 13.16 | 3.40 | 13.82 | 4.40 | 13.33 | 4.60 | 13.68 | 4.20 | 12.22 | 2.80 | 13.72 | 4.40 | - | - | - | - | - | - |
| | Grain, hay and mangolds, | 13.27 | 3.40 | 13.03 | 4.60 | 14.37 | 4.60 | 14.08 | 4.20 | 11.23 | 2.80 | 14.14 | 4.40 | - | - | - | - | - | - |
| | Average, | **13.21** | **3.40** | **13.41** | **4.50** | **13.85** | **4.60** | **13.88** | **4.20** | **11.72** | **2.80** | **13.93** | **4.40** | - | - | - | - | - | - |
| III.<br>28 days. | Grain and corn stover, | 14.02 | 4.80 | 13.47 | 4.00 | 14.27 | 5.00 | 14.38 | 4.20 | 11.73 | 3.00 | 14.13 | 5.00 | - | - | - | - | - | - |
| | Grain and corn stover, | - | - | 14.06 | 4.00 | 14.55 | 5.40 | - | - | - | - | 14.37 | 5.10 | 14.13 | 4.40 | - | - | - | - |
| | Average, | **14.02** | **4.80** | **13.76** | **4.00** | **14.41** | **5.20** | **14.38** | **4.20** | **11.73** | **3.00** | **14.25** | **5.05** | **14.13** | **4.40** | - | - | - | - |
| IV.<br>86 days. | Grain, hay, and corn and soja-bean ensilage, | - | - | 12.42 | 3.66 | - | - | - | - | - | - | 13.97 | 4.36 | - | - | - | - | - | - |
| | Grain, hay, and corn and soja-bean ensilage, | - | - | 13.14 | 4.22 | - | - | - | - | - | - | 13.31 | 4.42 | - | - | - | - | - | - |
| | Grain, hay, and corn and soja-bean ensilage, | - | - | 13.48 | 4.26 | - | - | - | - | - | - | 13.84 | - | - | - | - | - | - | - |
| | Grain, hay, and corn and soja-bean ensilage, | - | - | 12.96 | 4.30 | - | - | - | - | - | - | 13.81 | 4.62 | - | - | - | - | - | - |
| | Grain, hay, and corn and soja-bean ensilage, | - | - | 12.93 | 4.30 | - | - | - | - | - | - | 13.08 | 4.67 | - | - | - | - | - | - |
| | Grain, hay, and corn and soja bean ensilage, | - | - | 14.36 | 5.13 | 14.14 | 4.88 | - | - | - | - | 13.36 | 4.18 | 14.42 | 3.93 | 14.02 | 5.38 | - | - |
| | Grain, hay, and corn and soja-bean ensilage, | - | - | 13.09 | 4.06 | 14.05 | 4.90 | - | - | - | - | 13.83 | 4.22 | 14.35 | 5.20 | 14.58 | 5.26 | - | - |

## *Quality of Milk produced* — Concluded.

| Feeding Periods. | Rations. | May. |  | Gem. |  | Lucy. |  | Viola. |  | Anna. |  | Florence. |  | Jennie. |  | Julia. |  | Nora. |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. |
| IV. 86 days. | Grain, hay, and corn and soja-bean ensilage, | - | - | 13.33 | 4.19 | 14.03 | 4.89 | - | - | - | - | 14.24 | 4.68 | 14.22 | 5.18 | 14.48 | 5.27 | - | - |
|  | Grain, hay, and corn and soja-bean ensilage, | - | - | 13.72 | 4.76 | 14.25 | 4.88 | - | - | - | - | 14.14 | 4.82 | 14.43 | 5.27 | 14.04 | 4.86 | - | - |
|  | Grain, hay, and corn and soja bean ensilage, | - | - | 13.13 | 3.99 | - | - | - | - | - | - | 14.09 | 4.80 | 14.29 | 5.05 | 13.84 | 4.71 | - | - |
|  | Grain, hay, and corn and soja-bean ensilage, | - | - | 12.91 | 4.33 | - | - | - | - | - | - | 14.24 | 4.86 | - | - | 14.59 | 5.29 | - | - |
|  | Average, . . . . . . . . . | - | - | **13.22** | **4.72** | **14.12** | **4.89** | - | - | - | - | **13.99** | **4.56** | **14.34** | **4.92** | **14.26** | **5.13** | - | - |
| V. 25 days. | Grain, hay, and soja-bean and corn ensilage, | - | - | 13.09 | 4.08 | - | - | - | - | - | - | 13.82 | 4.52 | 14.63 | 5.33 | 13.85 | 4.75 | 13.49 | 3.99 |
|  | Grain, hay, and soja-bean and corn ensilage, | - | - | 13.13 | 4.05 | - | - | - | - | - | - | - | - | 14.68 | 5.41 | 13.76 | 4.70 | 13.86 | 4.23 |
|  | Grain, hay, and soja-bean and corn ensilage, | - | - | 13.38 | 4.31 | - | - | - | - | - | - | 13.50 | 4.34 | 14.20 | 5.39 | 13.84 | 4.69 | 13.59 | 3.86 |
|  | Grain, hay, and soja-bean and corn ensilage, | - | - | 13.17 | 3.77 | - | - | - | - | - | - | 13.50 | 4.21 | 14.38 | 5.09 | 13.32 | 4.75 | 13.97 | 4.34 |
|  | Average, . . . . . . . . . | - | - | **13.19** | **4.05** | - | - | - | - | - | - | **13.61** | **4.36** | **14.47** | **5.21** | **13.69** | **4.72** | **13.73** | **4.11** |
|  | *Part 2.* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| VI. 14 days. | Grain and hay of peas and oats, . . . | - | - | 13.29 | 4.10 | - | - | - | - | - | - | 13.81 | 4.20 | 14.64 | 5.11 | - | - | 13.50 | 4.41 |
|  | Grain and hay of peas and oats, . . . | - | - | 13.61 | 3.91 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|  | Average, . . . . . . . . . | - | - | **13.45** | **4.10** | - | - | - | - | - | - | **13.81** | **4.20** | **14.64** | **5.11** | - | - | **13.50** | **4.41** |
| VII. 9 days. | Grain and rowen, . . . . . . . . | - | - | 12.87 | 3.91 | - | - | - | - | - | - | 13.91 | 4.54 | 14.85 | 5.27 | 13.83 | 4.67 | 12.83 | 3.44 |
|  | Grain and rowen, . . . . . . . . | - | - | 13.09 | 4.09 | - | - | - | - | - | - | 13.85 | 4.51 | 13.96 | 4.25 | 13.78 | 4.39 | 12.86 | 4.18 |
|  | Average, . . . . . . . . . | - | - | **12.98** | **4.00** | - | - | - | - | - | - | **13.88** | **4.52** | **14.41** | **4.76** | **13.81** | **4.53** | **12.85** | **3.81** |

At the beginning of the experiment, samples of the milk were taken daily, but it was finally decided to make a composite sample of three days' milk (Monday, Tuesday and Wednesday) of each week, believing that in this way a better knowledge of the composition of the milk produced by the various cows could be obtained.

### *Did the Coarse Fodders Influence the Quality of the Milk?*

By the quality of the milk the percentages of total solids and of fat are referred to. A close study of the analyses of the milk in the various periods leads to the conclusion that the different coarse fodders exerted no decided influence upon the composition of the milk. There were variations from week to week, both in the percentage of total solids and of fat, but no marked change is noticed in any one particular period, and the slight variations that do occur should without doubt be attributed to the condition of the animal, and the consequent influence upon the secretion, rather than to any particular influence due to the feed consumed.

### *General Conclusions.*

This experiment confirms others made at the station, and points out the economy of raising and feeding a greater variety of coarse fodder articles, substituting them for the high-priced hay.

Corn and soja-bean ensilage has proved itself to be fully equal if not superior to hay in producing a yield of milk, without affecting the quality and at the same time decreasing the absolute cost. This ration produced milk at less than two cents per quart.

Roots, while they are beneficial to the health of the animals, especially those fed upon dry fodder, cannot be fed to any extent economically, because of the increased cost of the milk produced.

Hay of peas and oats proved itself to be nearly or quite equal to a good quality of rowen for milk production.

The different coarse fodders have not influenced the composition of the milk to any noticeable extent.

## FEEDING RECORD.

| FEEDING PERIODS | FEED CONSUMED (POUNDS) PER DAY. | | | | | | Dry Matter consumed per Day (Pounds). | Milk produced per Day (Quarts). | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. | Hay. | Corn Stover. | Mangolds. | | | | | |
| *May.* | | | | | | | | | | | |
| **1892-93.** | | | | | | | | | | | |
| Oct. 18 to Nov. 9, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | 21.88 | 6.34 | 3.45 | 1:4.5 | 982 |
| Nov. 14 to Dec. 3, | 3.00 | 3.00 | 3.00 | 15.00 | – | 15.00 | 23.60 | 6.47 | 3.65 | 1:4.9 | 992 |
| Dec. 12 to Jan. 9, | 3.00 | 3.00 | 3.00 | – | 13.43 | – | 19.69 | 4.93 | 3.99 | 1:4.6 | 1,023 |
| *Viola.* | | | | | | | | | | | |
| Oct. 18 to Nov. 9, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | 21.88 | 5.83 | 3.75 | 1:4.5 | 965 |
| Nov. 14 to Dec. 3, | 3.00 | 3.00 | 3.00 | 14.73 | – | 15.00 | 23.35 | 5.23 | 4.46 | 1:4.9 | 994 |
| Dec. 12 to Jan. 4, | 3.00 | 3.00 | 3.00 | – | 16.61 | – | 22.40 | 3.74 | 5.99 | 1:4.9 | 983 |
| *Anna.* | | | | | | | | | | | |
| Oct. 18 to Nov. 9, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | 21.88 | 5.80 | 3.77 | 1:4.5 | 1,010 |
| Nov. 14 to Dec. 3, | 3.00 | 3.00 | 3.00 | 10.21 | – | 15.00 | 19.24 | 5.70 | 3.38 | 1:4.4 | 1,040 |
| Dec. 12 to Jan 4, | 3.00 | 3.00 | 3.00 | – | 11.78 | – | 18.28 | 4.75 | 3.85 | 1:4.55 | 1,027 |

## FEEDING RECORD — *Continued.*

### *Gem.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | | | | | | | Dry Matter consumed per Day (Pounds). | Milk produced per Day (Quarts). | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. | Hay. | Rowen. | Corn Stover. | Hay of Peas and Oats. | Corn and Soja-bean Ensilage. | Soja-bean and Corn Ensilage. | Mangolds. | | | | | |
| **1892-93.** | | | | | | | | | | | | | | | |
| Oct. 18 to Nov. 9, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | – | – | – | – | 21.88 | 11.11 | 1.97 | 1:4.5 | 936 |
| Nov. 14 to Dec. 3, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | – | – | – | 15.00 | 23.60 | 11.93 | 1.98 | 1:4.9 | 961 |
| Dec. 12 to Jan. 10, | 3.00 | 3.00 | 3.00 | – | – | 13.34 | – | – | – | – | 19.61 | 9.26 | 2.12 | 1:4.6 | 929 |
| Jan. 18 to April 4, | 2.94 | 2.94 | 2.94 | 4.00 | – | – | – | 43.22 | – | – | 22.31 | 12.21 | 1.83 | 1:4.8 | 941 |
| May 1 to May 26, | 2.88 | 2.88 | 2.88 | 4.00 | – | – | – | – | 51.72 | – | 21.72 | 11.76 | 1.85 | 1:4.9 | 967 |
| June 8 to June 22, | 3.00 | 3.00 | 3.00 | – | – | – | 14.71 | – | – | – | 21.13 | 10.32 | 2.05 | 1:3.6 | 1,012 |
| June 27 to July 6, | 3.00 | 3.00 | 3.00 | – | 17.11 | – | – | – | – | – | 23.40 | 11.03 | 2.12 | 1:4.45 | 1,002 |
| ***Lucy.*** | | | | | | | | | | | | | | | |
| Oct. 18 to Nov. 9, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | – | – | – | – | 21.88 | 8.45 | 2.59 | 1:4.5 | 877 |
| Nov. 14 to Dec. 3, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | – | – | – | 15.00 | 23.60 | 8.84 | 2.67 | 1:4.9 | 888 |
| Dec. 12 to Jan. 10, | 3.00 | 3.00 | 3.00 | – | – | 12.31 | – | – | – | – | 18.74 | 6.69 | 2.80 | 1:4.5 | 869 |
| Feb. 18 to Mar. 15, | 3.00 | 3.00 | 3.00 | 4.00 | – | – | – | 25.84 | – | – | 17.61 | 7.30 | 2.41 | 1:4.0 | 865 |

## FEEDING RECORD — *Continued.*

### *Florence.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | | | | | | | Dry Matter consumed per Day (Pounds). | Milk produced per Day (Quarts). | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. | Hay. | Rowen. | Corn Stover. | Hay of Peas and Oats. | Corn and Soja-bean Ensilage. | Soja-bean and Corn Ensilage. | Mangolds. | | | | | |
| **1892-93.** | | | | | | | | | | | | | | | |
| Oct. 18 to Nov. 9, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | – | – | – | – | 21.88 | 10.46 | 2.09 | 1:4.5 | 944 |
| Nov. 14 to Dec. 3, | 3.00 | 3.00 | 3.00 | 15.00 | – | – | – | – | – | 15.00 | 23.60 | 10.58 | 2.23 | 1:4.9 | 974 |
| Dec. 12 to Jan. 10, | 3.00 | 3.00 | 3.00 | – | – | 13.17 | – | – | – | – | 19.47 | 7.12 | 2.73 | 1:4.6 | 962 |
| Jan. 18 to April 4, | 3.00 | 3.00 | 3.00 | 4.00 | – | – | – | 49.86 | – | – | 22.95 | 9.31 | 2.47 | 1:4.9 | 1,010 |
| May 1 to May 26, | 3.00 | 3.00 | 3.00 | 4.00 | – | – | – | – | 51.18 | – | 21.93 | 8.28 | 2.65 | 1:5.0 | 1,004 |
| June 8 to June 22, | 3.00 | 3.00 | 3.00 | – | – | – | 15.43 | – | – | – | 21.76 | 7.19 | 3.03 | 1:3.6 | 1,088 |
| June 27 to July 6, | 3.00 | 3.00 | 3.00 | – | 18.00 | – | – | – | – | – | 24.19 | 7.52 | 3.22 | 1:4.5 | 1,064 |

## FEEDING RECORD — *Concluded.*

### *Nora.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | | | | | Dry Matter consumed per Day (Pounds). | Milk produced per Day (Quarts). | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. | Hay. | Rowen. | Hay of Peas and Oats. | Corn and Soja-bean Ensilage. | Soja-bean and Corn Ensilage. | | | | | |
| **1892-93.** | | | | | | | | | | | | | |
| May 1 to May 26, . | 3.00 | 3.00 | 3.00 | 4.00 | - | - | - | 49.14 | 21.53 | 11.45 | 1.88 | 1:5.00 | 730 |
| June 8 to June 22, . | 3.00 | 3.00 | 3.00 | - | - | 13.71 | - | - | 19.65 | 10.48 | 1.88 | 1:3.50 | 744 |
| June 27 to July 6, . | 3.00 | 3.00 | 3.00 | - | 16.00 | - | - | - | 22.42 | 10.59 | 2.12 | 1:4.40 | 743 |
| *Jennie.* | | | | | | | | | | | | | |
| Feb 12 to April 4, . | 3.00 | 3.00 | 3.00 | 4.00 | - | - | 40.45 | - | 20.86 | 10.80 | 1.93 | 1:4.80 | 706 |
| May 1 to May 26, . | 3.00 | 3.00 | 3.00 | 4.00 | - | - | - | 45.16 | 20.75 | 9.48 | 2.19 | 1:4.90 | 728 |
| June 8 to June 22, . | 3.00 | 3.00 | 3.00 | - | - | 14.71 | - | - | 21.13 | 8.66 | 2.44 | 1:3.55 | 759 |
| June 27 to July 6, . | 3.00 | 3.00 | 3.00 | - | 16.00 | - | - | - | 22.42 | 8.19 | 2.74 | 1:4.40 | 740 |
| *Julia.* | | | | | | | | | | | | | |
| Feb. 20 to April 4, . | 3.00 | 3.00 | 3.00 | 4.00 | - | - | 47.44 | - | 22.42 | 12.88 | 1.74 | 1:4.90 | 824 |
| May 1 to May 26, . | 3.00 | 3.00 | 3.00 | 4.00 | - | - | - | 50.22 | 21.75 | 11.51 | 1.89 | 1:5.00 | 801 |
| June 27 to July 6, . | 3.00 | 3.00 | 3.00 | - | 16.00 | - | - | - | 22.42 | 9.30 | 2.41 | 1:4.40 | 790 |

### TOTAL COST OF FEED PER QUART OF MILK.

| FEEDING PERIODS. | Quantity of Milk produced (Quarts). | Average Daily Yield (Quarts). | Wheat Bran consumed (Pounds). | Buffalo Gluten Feed consumed (Pounds). | Cotton-seed Meal consumed (Pounds). | Hay consumed (Pounds). | Corn Stover consumed (Pounds). | Globe Mangolds consumed (Pounds). | Total Cost of Feed consumed. | Cost of Feed per Quart of Milk produced (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|
| *May.* | | | | | | | | | | |
| **1892-93.** | | | | | | | | | | |
| Oct. 18 to Nov. 9, . . . . . . | 139.48 | 6.34 | 66.00 | 66.00 | 66.00 | 330.00 | – | – | $4 69 | 3.36 |
| Nov. 14 to Dec. 3, . . . . . . | 122.93 | 6.47 | 57.00 | 57.00 | 57.00 | 285.00 | – | 285.00 | 4 62 | 3.75 |
| Dec. 12 to Jan. 9, . . . . . . | 138.04 | 4.93 | 84.00 | 84.00 | 84.00 | – | 376.00 | – | 3 75 | 2.72 |
| *Viola.* | | | | | | | | | | |
| Oct. 18 to Nov. 9, . . . . . . | 128.14 | 5.83 | 66.00 | 66.00 | 66.00 | 330.00 | – | – | $4 69 | 3.65 |
| Nov. 14 to Dec 3, . . . . . . | 99.41 | 5.23 | 57.00 | 57.00 | 57.00 | 281.00 | – | 285.00 | 4 58 | 4.61 |
| Dec. 12 to Jan. 4, . . . . . . | 86.12 | 3.74 | 69.00 | 69.00 | 69.00 | – | 382.00 | – | 3 26 | 3.78 |
| *Anna.* | | | | | | | | | | |
| Oct. 18 to Nov. 9, . . . . . . | 127.07 | 5.80 | 66.00 | 66.00 | 66.00 | 330.00 | – | – | $4 69 | 3.69 |
| Nov. 14 to Dec. 3, . . . . . . | 108.30 | 5.70 | 57.00 | 57.00 | 57.00 | 194.00 | – | 285.00 | 3 93 | 3.60 |
| Dec. 12 to Jan. 4, . . . . . . | 109.25 | 4.75 | 69.00 | 69.00 | 69.00 | – | 271.00 | – | 2 97 | 2.72 |

## Total Cost of Feed per Quart of Milk — *Continued.*

### *Gem.*

| Feeding Periods. | Quantity of Milk produced (Quarts). | Average Daily Yield (Quarts). | Wheat Bran consumed (Pounds). | Buffalo Gluten Feed consumed (Pounds). | Cotton-seed Meal consumed (Pounds). | Hay consumed (Pounds). | Rowen consumed (Pounds). | Corn Stover consumed (Pounds). | Hay of Peas and Oats consumed (Pounds). | Corn and Soja-bean Ensilage consumed (Pounds). | Soja-bean and Corn Ensilage consumed (Pounds). | Globe Mangolds consumed (Pounds). | Total Cost of Feed consumed. | Cost of Feed per Quart of Milk produced (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1892-93.** | | | | | | | | | | | | | | |
| Oct. 18 to Nov. 9, . | 244.51 | 11.11 | 66.00 | 66.00 | 66.00 | 330.00 | – | – | – | – | – | – | $4 69 | 1.88 |
| Nov. 14 to Dec. 3, . | 226.67 | 11.93 | 57.00 | 57.00 | 57.00 | 285.00 | – | – | – | – | – | 285.00 | 4 62 | 2.04 |
| Dec. 12 to Jan 10, . | 268.54 | 9.26 | 87.00 | 87.00 | 87.00 | – | – | 387.00 | – | – | – | – | 3 87 | 1.44 |
| Jan. 18 to April 4, . | 927.96 | 12.21 | 223.50 | 223.50 | 223.50 | 304.00 | – | – | – | 3,285.00 | – | – | 14 53 | 1.56 |
| May 1 to May 26, . | 294.00 | 11.76 | 72.00 | 72.00 | 72.00 | 100.00 | – | – | – | – | 1,293.00 | – | 4 97 | 1.69 |
| June 8 to June 22, . | 144.48 | 10.32 | 42.00 | 42.00 | 42.00 | – | – | – | 206.00 | – | – | – | 2 95 | 2.04 |
| June 27 to July 6, . | 99.27 | 11.03 | 27.00 | 27.00 | 27.00 | – | 154.00 | – | – | – | – | – | 2 05 | 2.04 |

### *Lucy.*

| Feeding Periods. | Quantity of Milk produced (Quarts). | Average Daily Yield (Quarts). | Wheat Bran consumed (Pounds). | Buffalo Gluten Feed consumed (Pounds). | Cotton-seed Meal consumed (Pounds). | Hay consumed (Pounds). | Rowen consumed (Pounds). | Corn Stover consumed (Pounds). | Hay of Peas and Oats consumed (Pounds). | Corn and Soja-bean Ensilage consumed (Pounds). | Soja-bean and Corn Ensilage consumed (Pounds). | Globe Mangolds consumed (Pounds). | Total Cost of Feed consumed. | Cost of Feed per Quart of Milk produced (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct. 18 to Nov. 9, . | 185.90 | 8.45 | 66.00 | 66.00 | 66.00 | 330.00 | – | – | – | – | – | – | $4 69 | 2.52 |
| Nov. 14 to Dec. 3, . | 167.96 | 8.84 | 57.00 | 57.00 | 57.00 | 285.00 | – | – | – | – | – | 285.00 | 4 62 | 2.75 |
| Dec. 12 to Jan. 10, . | 193.02 | 6.65 | 87.00 | 87.00 | 87.00 | – | – | 357.00 | – | – | – | – | 3 80 | 1.97 |
| Feb. 18 to Mar. 15, . | 182.50 | 7.30 | 75.00 | 75.00 | 75.00 | 100.00 | – | – | – | 646.00 | – | – | 4 16 | 2.28 |

### TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

*Florence.*

| FEEDING PERIODS. | Quantity of Milk produced (Quarts). | Average Daily Yield (Quarts). | Wheat Bran consumed (Pounds). | Buffalo Gluten Feed consumed (Pounds). | Cotton-seed Meal consumed (Pounds). | Hay consumed (Pounds). | Rowen consumed (Pounds). | Corn Stover consumed (Pounds). | Hay of Peas and Oats consumed (Pounds). | Corn and Soja-bean Ensilage consumed (Pounds). | Soja-bean and Corn Ensilage consumed (Pounds). | Globe Mangolds consumed (Pounds). | Total Cost of Feed consumed. | Cost of Feed per Quart of Milk produced (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct. 18 to Nov. 9, . | 230.12 | 10.46 | 66.00 | 66.00 | 66.00 | 330.00 | – | – | – | – | – | – | $4 68 | 2.03 |
| Nov. 14 to Dec. 3, . | 201.02 | 10.58 | 57.00 | 57.00 | 57.00 | 285.00 | – | – | – | – | – | 285.00 | 4 62 | 2.29 |
| Dec. 12 to Jan. 10, . | 206.48 | 7.12 | 87.00 | 87.00 | 87.00 | – | – | 382.00 | – | – | – | – | 3 87 | 1.87 |
| Jan. 18 to April 4, . | 707.56 | 9.31 | 228.00 | 228.00 | 228.00 | 304.00 | – | – | – | 3,789.00 | – | – | 15 11 | 2.13 |
| May 1 to May 26, . | 207.00 | 8.28 | 75.00 | 75.00 | 75.00 | 100.00 | – | – | – | – | 1,279.00 | – | 5 05 | 2.44 |
| June 8 to June 22, . | 100.66 | 7.19 | 42.00 | 42.00 | 42.00 | – | – | – | 216.00 | – | – | – | 3 03 | 3.02 |
| June 27 to July 6, . | 67.67 | 7.52 | 27.00 | 27.00 | 27.00 | – | 172.00 | – | – | – | – | – | 2 14 | 3.16 |

## TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

*Nora.*

| FEEDING PERIODS. | Quantity of Milk produced (Quarts). | Average Daily Yield (Quarts). | Wheat Bran consumed (Pounds). | Buffalo Gluten Feed consumed (Pounds). | Cotton-seed Meal consumed (Pounds). | Hay consumed (Pounds). | Rowen consumed (Pounds). | Hay of Peas and Oats consumed (Pounds). | Corn and Soja-bean Ensilage consumed (Pounds). | Soja-bean and Corn Ensilage consumed (Pounds). | Total Cost of Feed consumed. | Cost of Feed per Quart of Milk produced (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1893.** | | | | | | | | | | | | |
| May 1 to May 26, . . | 286.25 | 11.45 | 75.00 | 75.00 | 75.00 | 100.00 | – | – | – | 1,229.00 | $4 88 | 1.74 |
| June 8 to June 22, . . | 146.72 | 10.48 | 42.00 | 42.00 | 42.00 | – | – | 192.00 | – | – | 2 85 | 1.94 |
| June 27 to July 6, . . | 95.31 | 10.59 | 27.00 | 27.00 | 27.00 | – | 144.00 | – | – | – | 1 98 | 2.07 |

*Jennie.*

| FEEDING PERIODS. | Quantity of Milk produced (Quarts). | Average Daily Yield (Quarts). | Wheat Bran consumed (Pounds). | Buffalo Gluten Feed consumed (Pounds). | Cotton-seed Meal consumed (Pounds). | Hay consumed (Pounds). | Rowen consumed (Pounds). | Hay of Peas and Oats consumed (Pounds). | Corn and Soja-bean Ensilage consumed (Pounds). | Soja-bean and Corn Ensilage consumed (Pounds). | Total Cost of Feed consumed. | Cost of Feed per Quart of Milk produced (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb. 12 to April 4, . . | 248.40 | 10.80 | 69.00 | 69.00 | 69.00 | 92.00 | – | – | 930.00 | – | $4 29 | 1.73 |
| May 1 to May 26, . . | 237.00 | 9.48 | 75.00 | 75.00 | 75.00 | 100.00 | – | – | – | 1,129.00 | 4 84 | 2.04 |
| June 8 to June 22, . . | 121.26 | 8.66 | 42.00 | 42.00 | 42.00 | – | – | 206.00 | – | – | 2 95 | 2.42 |
| June 27 to July 6, . . | 73.79 | 8.16 | 27.00 | 27.00 | 27.00 | – | 144.00 | – | – | – | 1 98 | 2.71 |

*Julia.*

| FEEDING PERIODS. | Quantity of Milk produced (Quarts). | Average Daily Yield (Quarts). | Wheat Bran consumed (Pounds). | Buffalo Gluten Feed consumed (Pounds). | Cotton-seed Meal consumed (Pounds). | Hay consumed (Pounds). | Rowen consumed (Pounds). | Hay of Peas and Oats consumed (Pounds). | Corn and Soja-bean Ensilage consumed (Pounds). | Soja-bean and Corn Ensilage consumed (Pounds). | Total Cost of Feed consumed. | Cost of Feed per Quart of Milk produced (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb. 20 to April 4, . . | 180.32 | 12.88 | 42.00 | 42.00 | 42.00 | 56.00 | – | – | 664.00 | – | $2 80 | 1.55 |
| May 1 to May 26, . . | 287.75 | 11.51 | 75.00 | 75.00 | 75.00 | 100.00 | – | – | – | 1,256.00 | 5 01 | 1.74 |
| June 27 to July 6, . . | 83.70 | 9.30 | 27.00 | 27.00 | 27.00 | – | 144.00 | – | – | – | 1 98 | 2.37 |

## 2. Summer Feeding Experiments with Milch Cows.

### *July, 1892, to September, 1892.*

[Coarse fodder articles: rowen, green vetch and oats and green corn fodder; grain feed: wheat bran, Buffalo gluten feed, cotton-seed meal and new process linseed meal.]

### *Object of the Experiment.*

This experiment had for its object the studying of the comparative value of three distinct fodder rations on the economical production of milk and cream during the summer season.

The first ration consisted of green vetch and oats *ad libitum*, four pounds of rowen and three pounds each of wheat bran, Buffalo gluten feed and cotton-seed meal.

The second ration consisted of rowen *ad libitum* and three pounds each of wheat bran, Buffalo gluten feed and new-process linseed meal.

The third ration consisted of four pounds of rowen, all the corn fodder the animal could eat, and three pounds each of wheat bran, Buffalo gluten feed and new-process linseed meal.

The vetch and oats were cut when in bloom, and the corn fodder when the kernels were beginning to glaze.

Four pounds of rowen were fed daily in connection with the green fodder. The daily consumption of green fodder was governed by the individual appetite of the animals, and usually decreased with the advancing stage of growth of the fodder plant. The feeding of the green crops ceased as soon as they neared maturity, and they were then cut and made into hay, or, in the case of corn fodder, placed in the silo.

The cows were grades of various description, and the general management of the experiment was the same as in the one immediately preceding.

### *History of Cows.*

| NAME OF COW. | BREED. | Age (Years). | LAST CALF DROPPED. | Daily Yield of Milk at Beginning of Trial (Quarts). | Number of Months on Trial. |
|---|---|---|---|---|---|
| Jennie, . | Grade Jersey, . | 4 | Dec. 25, 1892, . | 8–9 | 7 |
| Gem, . | Grade Shorthorn, | 5 | Dec. 6, 1891, . | 7–8 | 17 |
| Florence, . | Grade Shorthorn, | 7 | May 13, 1892, . | 9–10 | 14 |
| Julia, . | Native, . . | 9 | Jan. 18, 1893, . | 9–10 | 6 |
| Nora, . | Grade Ayrshire, . | 5 | Mar. 25, 1893, . | 10–11 | 4 |
| Nettie, . | Grade Holstein, . | 5 | July 2, 1893, . | 15–16 | – |

### *Local Market Cost per Ton of the Various Articles of Fodder.*

| | |
|---|---|
| Wheat bran, . . . . . . . . . . . . | $18 00 |
| Buffalo gluten feed, . . . . . . . . . . | 19 00 |
| Cotton-seed meal, . . . . . . . . . . | 28 00 |
| New-process linseed meal, . . . . . . . . | 26 00 |
| Rowen, . . . . . . . . . . . . . | 15 00 |
| Vetch and oats (green), . . . . . . . . | 2 75 |
| Corn fodder (green), . . . . . . . . . . | 2 50 |

### *Analyses of the Various Articles of Fodder used.*

| FODDER ANALYSES. | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. | New-process Linseed Meal. | Rowen. | Vetch and Oats. | Corn Fodder. |
|---|---|---|---|---|---|---|---|
| Moisture at 100° C., . | 12.00 | 9.38 | 8.71 | 10.62 | 11.30 | 79.16 | 80.89 |
| Dry matter, . . | 88.00 | 90.62 | 91.29 | 89.38 | 88.70 | 20.84 | 19.11 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | | | |
| Crude ash, . . . | 7.70 | 0.98 | 7.62 | 5.89 | 6.48 | 8.80 | 6.29 |
| " cellulose, . | 11.10 | 8.06 | 8.28 | 8.84 | 29.98 | 30.34 | 26.38 |
| " fat, . . . | 5.80 | 14.47 | 9.50 | 3.94 | 4.23 | 3.90 | 1.75 |
| " protein, . . | 17.83 | 25.79 | 43.56 | 40.79 | 12.11 | 13.27 | 6.05 |
| Non-nitrogenous extract matter, . . | 57.57 | 50.70 | 31.04 | 40.54 | 47.20 | 43.69 | 59.53 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

### *Fertilizing Constituents.*

[Nitrogen 17½ cents, phosphoric acid 5 cents, potassium oxide 5½ cents, per pound.]

| FERTILIZER ANALYSES. | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. | New-process Linseed Meal. | Rowen. | Vetch and Oats. | Corn Fodder. |
|---|---|---|---|---|---|---|---|
| Moisture, | 12.00 | 9.38 | 8.71 | 10.62 | 11.30 | 79.16 | 80.89 |
| Nitrogen, | 2.51 | 3.74 | 6.36 | 5.84 | 1.72 | 0.44 | 0.19 |
| Phosphoric acid, | 2.85 | 0.46 | 3.17 | 1.95 | 0.47 | 0.13 | 0.15 |
| Potassium oxide, | 1.63 | 0.10 | 2.25 | 1.08 | 1.63 | 0.42 | 0.33 |
| Valuation per 2,000 pounds, | $13 39 | $13 64 | $27 90 | $23 58 | $8 28 | $2 13 | $1 17 |
| Manurial value obtainable, | 10 71 | 10 91 | 22 32 | 18 64 | 6 62 | 1 70 | 0 94 |

### *Average Composition of the Daily Fodder Rations used during the Three Successive Feeding Periods.*

| I. | | II. | |
|---|---|---|---|
| *July 13 to July 24.* | | *August 10 to August 28.* | |
| Wheat bran, | 3 lbs. | Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " | Buffalo gluten feed, | 3 " |
| Cotton-seed meal, | 3 " | New-process linseed meal, | 3 " |
| Rowen, | 4 " | Rowen, | 18 " |
| Vetch and oats, | 40 " | Nutritive ratio, | 1:4.41 |
| Nutritive ratio, | 1:3.79 | Total cost, | 22.95 cts. |
| Total cost, | 18.25 cts. | Manurial value obtainable, | 12.00 " |
| Manurial value obtainable, | 11.32 " | Net cost, | 10.95 " |
| Net cost, | 6.93 " | | |

| III. | |
|---|---|
| *September 4 to September 28.* | |
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| New-process linseed meal, | 3 " |
| Rowen, | 4 " |
| Corn fodder, | 55 " |
| Nutritive ratio, | 1:5.06 |
| Total cost, | 19.33 cts. |
| Manurial value obtainable, | 9.95 " |
| Net cost, | 9.38 " |

*Summary of Cost of the Average Daily Fodder Rations.*

[Cents.]

| | FEEDING PERIODS. | | |
|---|---|---|---|
| | I. | II. | III. |
| Total cost, | 18.25 | 22.95 | 19.33 |
| Manurial value obtainable, | 11.32 | 12.00 | 9.95 |
| Net cost, | 6.93 | 10.95 | 9.38 |

*Quantity of Milk produced per Day, and Cost of Same per Quart.*

| FEEDING PERIODS. | JENNIE. | | GEM. | | FLORENCE. | | JULIA. | | NORA. | | NETTIE. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Yield. | Cost per Quart. | Daily Yield. | Cost per Quart | Daily Yield. | Cost per Quart. | Daily Yield. | Cost per Quart. | Daily Yield. | Cost per Quart. | Daily Yield. | Cost per Quart. |
| | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. | Qts. | Cts. |
| I., | 7.36 | 2.40 | 6.87 | 2.75 | 9.37 | 2.02 | 9.00 | 1.96 | 9.64 | 1.83 | – | – |
| II., | 7.12 | 3.22 | 8.94 | 2.41 | 7.02 | 3.28 | 8.95 | 2.54 | 9.02 | 2.55 | 14.27 | 1.61 |
| III., | 6.43 | 2.81 | 8.40 | 2.18 | 6.01 | 3.09 | 8.26 | 2.19 | 8.89 | 2.09 | 15.83 | 1.25 |

*Composition of Milk produced.*

| FEEDING PERIODS. | RATIONS. | JENNIE. | | GEM. | | FLORENCE. | | JULIA. | | NORA. | | NETTIE. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. | Total Solids. | Fat. |
| I. Ten days, . . | Wheat bran, Buffalo gluten feed, cotton-seed meal, rowen and vetch and oats, | 15.01 | 5.55 | 13.75 | 3.95 | 13.59 | 4.83 | 13.39 | 4.85 | 13.18 | 4.08 | - | - |
| | | 15.01 | 5.55 | 13.75 | 3.95 | 13.59 | 4.83 | 13.39 | 4.85 | 13.18 | 4.08 | - | - |
| II. Eighteen days, . | Wheat bran, Buffalo gluten feed, new-process linseed meal and rowen, . . | 14.54 | 4.28 | 13.56 | 4.76 | 14.28 | 4.83 | 13.72 | 4.30 | 13.07 | 3.89 | 12.37 | 3.56 |
| | | 14.55 | 5.06 | 12.80 | 4.08 | 13.81 | 4.81 | 13.62 | 4.72 | 13.46 | 4.78 | 12.63 | 3.86 |
| | | 14.54 | 4.67 | 13.18 | 4.42 | 14.04 | 4.82 | 13.67 | 4.51 | 13.26 | 4.34 | 12.50 | 3.71 |
| III. Twenty-four days, | Wheat bran, Buffalo gluten feed, new-process linseed meal, rowen and corn fodder, . . . . | 15.87 | 6.09 | 13.77 | 4.64 | 14.75 | 5.11 | 14.78 | 5.38 | 13.58 | - | 12.60 | 3.80 |
| | | 15.49 | 5.10 | 13.55 | 3.85 | 14.09 | 4.05 | 14.48 | 4.35 | 13.47 | 3.30 | 12.59 | 3.30 |
| | | 15.16 | 5.61 | 13.18 | 4.00 | - | - | 14.67 | 4.80 | 12.27 | 2.65 | 12.68 | 3.65 |
| | | 15.84 | 5.60 | 13.50 | 4.16 | 14.42 | 4.58 | 14.64 | 4.84 | 13.11 | 2.98 | 12.62 | 3.58 |

### *Results of the Experiment.*

There is a gradual decline in the yield of milk in case of four out of the six cows, owing to a rather advanced period of lactation. Nevertheless, it is to be observed that all three rations produced a very fair yield of milk, but the cost of the same differs. The average cost per quart for the six cows in the second feeding period, where rowen was the coarse feed, was 2.60 cents. In the first feeding period, where green vetch and oats was the chief coarse fodder, the average cost in case of five cows was 2.19 cents per quart; while in the third period, where green fodder corn was the chief coarse fodder, the average cost for the six cows was 2.30 cents per quart. In case, therefore, of feeding periods I. and III., milk is produced at an average price of 2¼ cents per quart, which is fairly low, considering the advanced period of lactation of three of the cows. In feeding period II., on the other hand, the milk cost 2.60 cents per quart, which shows that other cheaper coarse fodders must be substituted for the costly hay in order to produce milk at a minimum cost.

As far as the effect of feed upon the quality of the milk is concerned, there appears to be no distinct steady increase or decrease in composition. Variations are noticeable, generally slight ones, from week to week in the composition of each cow's milk. In one or two cases these differences are quite marked, being as high as one per cent. in case of fat; but it is plainly evident that such variations are brought about by the condition of the animal, and not by particular influence of the feed.

The results in previous years, with soja-bean, Southern cow-pea, serradella, green rye and peas and oats have already been published. They point out clearly the fact that a well-regulated system of feeding the dairy stock during the summer is necessary in order to secure the most satisfactory results.

## FEEDING RECORD.

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | | | | Dry Matter consumed per Day (Pounds). | Milk produced per Day (Quarts). | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. | New-process Linseed Meal. | Rowen. | Vetch and Oats. | Corn Fodder. | | | | | |
| | | | | | *Jennie.* | | | | | | | |
| **1893.** | | | | | | | | | | | | |
| July 13 to July 24, . . . | 3.00 | 3.00 | 3.00 | – | 4.00 | 36.00 | – | 19.15 | 7.36 | 2.60 | 1:3.70 | 750 |
| Aug. 10 to Aug. 28, . . . | 3.00 | 3.00 | – | 3.00 | 18.00 | – | – | 24.01 | 7.12 | 3.37 | 1:4.41 | 763 |
| Sept. 4 to Sept 28, . . . | 3.00 | 3.00 | – | 3.00 | 4.00 | – | 47.71 | 20.71 | 6.43 | 3.22 | 1:5.00 | 734 |
| | | | | | *Gem.* | | | | | | | |
| July 13 to July 24, . . . | 3.00 | 3.00 | 3.00 | – | 4.00 | 45.00 | – | 21.02 | 6.87 | 3.06 | 1:3.85 | 1,090 |
| Aug. 10 to Aug. 28, . . . | 3.00 | 3.00 | – | 3.00 | 16.83 | – | – | 22.97 | 8.94 | 2.57 | 1:4.36 | 998 |
| Sept. 4 to Sept. 28, . . . | 3.00 | 3.00 | – | 3.00 | 4.00 | – | 49.54 | 21.06 | 8.40 | 2.51 | 1:5.00 | 983 |
| | | | | | *Florence.* | | | | | | | |
| July 13 to July 24, . . . | 3.00 | 3.00 | 3.00 | – | 4.00 | 45.00 | – | 21.02 | 9.37 | 2.24 | 1:3.85 | 1,005 |
| Aug. 10 to Aug. 28, . . . | 3.00 | 3.00 | – | 3.00 | 18.00 | – | – | 24.01 | 7.02 | 3.42 | 1:4.41 | 1,020 |
| Sept. 4 to Sept 28, . . . | 3.00 | 3.00 | – | 3.00 | 4.00 | – | 51.43 | 21.42 | 6.07 | 3.53 | 1:5.00 | 1,044 |

*Julia.*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| July 13 to July 24, . . . | 3.00 | 3.00 | 3.00 | – | 4.00 | 36.00 | – | 19.15 | 9.00 | 2.13 | 1:3.70 | 795 |
| Aug. 10 to Aug. 28, . . . | 3.00 | 3.00 | – | 3.00 | 17.72 | – | – | 23.76 | 8.95 | 2.65 | 1:4.40 | 808 |
| Sept. 4 to Sept. 28, . . . | 3.00 | 3.00 | – | 3.00 | 4.00 | – | 48.10 | 20.78 | 8.26 | 2.52 | 1:5.00 | 818 |

*Nora.*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| July 13 to July 24, . . . | 3.00 | 3.00 | 3.00 | – | 4.00 | 36.00 | – | 19.15 | 9.64 | 1.99 | 1:3.70 | 740 |
| Aug. 10 to Aug. 28, . . . | 3.00 | 3.00 | – | 3.00 | 18.00 | – | – | 24.01 | 9.02 | 2.66 | 1:4.41 | 748 |
| Sept. 4 to Sept. 28, . . . | 3.00 | 3.00 | – | 3.00 | 4.00 | – | 51.80 | 21.49 | 8.89 | 2.42 | 1:5.00 | 762 |

*Nettie.*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aug. 10 to Aug. 28, . . . | 3.00 | 3.00 | – | 3.00 | 18.00 | – | – | 24.01 | 14.27 | 1.68 | 1:4.41 | 811 |
| Sept. 4 to Sept. 28, . . . | 3.00 | 3.00 | – | 3.00 | 4.00 | – | 59.15 | 22.89 | 15.83 | 1.45 | 1:5.10 | 831 |

## TOTAL COST OF FEED PER QUART OF MILK.

| FEEDING PERIODS. | Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Wheat Bran consumed (Pounds). | Buffalo Gluten Feed consumed (Pounds). | Cotton-seed Meal consumed (Pounds). | Linseed Meal consumed (Pounds). | Rowen consumed (Pounds). | Green Vetch and Oats consumed (Pounds). | Corn Fodder consumed (Pounds). | Total Cost of Feed consumed. | Cost of Feed per Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Jennie.* | | | | | | | | | | | |
| 1893. | | | | | | | | | | | |
| July 13 to July 24, . . | 80.96 | 7.36 | 33.00 | 33.00 | 33.00 | – | 44.00 | 396.00 | – | $1 94 | 2.40 |
| Aug. 10 to Aug. 28, . . | 128.16 | 7.12 | 54.00 | 54.00 | – | 54.00 | 324.00 | – | – | 4 13 | 3.22 |
| Sept. 4 to Sept. 28, . . | 154.32 | 6.43 | 72.00 | 72.00 | – | 72.00 | 96.00 | – | 1,145.00 | 4 34 | 2.81 |
| *Gem.* | | | | | | | | | | | |
| July 13 to July 24, . . | 75.57 | 6.87 | 33.00 | 33.00 | 33.00 | – | 44.00 | 495.00 | – | $2 08 | 2.76 |
| Aug. 10 to Aug. 28, . . | 160.92 | 8.94 | 54.00 | 54.00 | – | 54.00 | 303.00 | – | – | 3 97 | 2.47 |
| Sept. 4 to Sept. 28, . . | 201.60 | 8.40 | 72.00 | 72.00 | – | 72.00 | 96.00 | – | 1,189.00 | 4 39 | 2.18 |
| *Florence.* | | | | | | | | | | | |
| July 13 to July 24, . . | 103.07 | 9.37 | 33.00 | 33.00 | 33.00 | – | 44.00 | 495.00 | – | $2 08 | 2.02 |
| Aug. 10 to Aug. 28, . . | 126.36 | 7.02 | 54.00 | 54.00 | – | 54.00 | 324.00 | – | – | 4 43 | 3.27 |
| Sept. 4 to Sept. 19, . . | 91.05 | 6.07 | 45.00 | 45.00 | – | 45.00 | 60.00 | – | 763.00 | 2 82 | 3.09 |

*Julia.*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| July 13 to July 24, . . | 99.00 | 9.00 | 33.00 | 33.00 | 33.00 | – | 44.00 | 396.00 | – | $1 94 | 1.96 |
| Aug. 10 to Aug. 28, . . | 161.10 | 8.95 | 54.00 | 54.00 | – | 54.00 | 319.00 | – | – | 4 09 | 2.54 |
| Sept 4 to Sept. 28, . . | 198.24 | 8.26 | 72.00 | 72.00 | – | 72.00 | 96.00 | – | 1,154.00 | 4 35 | 2.19 |

*Nora.*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| July 13 to July 24, . . | 106.04 | 9.64 | 33.00 | 33.00 | 33.00 | – | 44.00 | 396.00 | – | $1 94 | 1.83 |
| Aug. 10 to Aug. 28, . . | 162.36 | 9.02 | 54.00 | 54.00 | – | 54.00 | 324.00 | – | – | 4 13 | 2.54 |
| Sept. 4 to Sept. 28, . . | 213.36 | 8.89 | 72.00 | 72.00 | – | 72.00 | 96.00 | – | 1,243.00 | 4 46 | 2.09 |

*Nettie.*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aug. 10 to Aug. 28, . . | 256.86 | 14.27 | 54.00 | 54.00 | – | 54.00 | 324.00 | – | – | $4 13 | 1.61 |
| Sept. 4 to Sept. 28, . . | 379.92 | 15.83 | 72.00 | 72.00 | – | 72.00 | 96.00 | – | 1,419.00 | 4 68 | 1.23 |

## 3. Creamery Record of the Station for 1892 and 1893.

The cost of feed consumed is based on the market prices stated below. The valuation of the whole milk is taken at three cents per quart.

*Local Market Cost per Ton of the Various Articles of Fodder used.*

| | |
|---|---|
| Wheat bran, | $19 00 |
| Buffalo gluten feed, | 20 00 |
| Cotton-seed meal, | 28 00 |
| New-process linseed meal, | 26 00 |
| Hay, | 15 00 |
| Rowen, | 15 00 |
| Corn fodder (green), | 2 50 |
| Corn stover, | 5 00 |
| Corn and soja-bean ensilage, | 2 75 |
| Soja-bean and corn ensilage, | 2 75 |
| Serradella and Hungarian grass ensilage, | 2 75 |
| Hay of peas and oats, | 15 00 |
| Hay of vetch and oats, | 15 00 |
| Vetch and oats (green), | 2 50 |
| Buckwheat (green), | 2 50 |
| Vetch (green), | 3 00 |
| Globe mangolds, | 4 00 |

*Fertilizing Constituents.*

[Nitrogen 17½ cents, phosphoric acid 5 cents, potassium oxide 5½ cents, per pound.]

| | Moisture. | Nitrogen. | Phosphoric Acid. | Potassium Oxide. | Valuation per 2,000 Pounds. |
|---|---|---|---|---|---|
| Wheat bran, | 11.17 | 2.48 | 2.85 | 1.63 | $13 31 |
| Buffalo gluten feed, | 8.83 | 3.78 | 0.05 | 0.10 | 13 80 |
| Cotton-seed meal, | 7.85 | 6.47 | 2.75 | 1.98 | 27 57 |
| New-process linseed meal, | 10.62 | 5.84 | 1.95 | 1.08 | 23 58 |
| Hay, | 9.00 | 1.52 | 0.35 | 1.54 | 7 36 |
| Rowen, | 11.30 | 1.72 | 0.47 | 1.63 | 8 28 |
| Corn fodder (green), | 80.89 | 0.19 | 0.15 | 0.33 | 1 17 |
| Corn stover, | 14.66 | 0.55 | 3.23 | 1.84 | 7 17 |
| Corn and soja-bean ensilage, | 77.77 | 0.32 | 0 12 | 0.48 | 1 77 |
| Soja-bean and corn ensilage, | 80.33 | 0.27 | 0.12 | 0.48 | 1 59 |
| Serradella and Hungarian grass ensilage, | 80.83 | 0.45 | 0.12 | 0.48 | 2 22 |
| Hay of peas and oats, | 12.30 | 2.24 | 0.65 | 2.10 | 10 80 |
| Hay of vetch and oats, | 9.95 | 2.44 | 0.65 | 2.10 | 11 50 |
| Vetch and oats (green), | 79.16 | 0.44 | 0.13 | 0.42 | 2 13 |
| Buckwheat (green), | 85.00 | 0.39 | 0.08 | 0.38 | 1 86 |
| Vetch (green), | 82.00 | 0.56 | 0.21 | 0.17 | 2 35 |
| Globe mangolds, | 88.51 | 0.13 | 0.10 | 0.47 | 1 07 |

### *Fertilizing Constituents of Cream.*

[Average Analysis.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 72.00-74.00 |
| Nitrogen (17½ cents per pound), | 0.54 |
| Phosphoric acid (5 cents per pound), | 0.17 |
| Potassium oxide (5½ cents per pound), | 0.12 |

The monthly value placed upon the cream is the price paid for the same by the local creamery. The financial statement is based on the local cost of feed, and does not take into consideration interest on investment or cost of labor involved.

The results here presented are stated under the following separate headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and fodder rations.
3. Value of cream at creamery basis of valuation.
4. Cost of skim-milk on the basis of three cents per quart for whole milk.
5. What the creamery records show.
6. Analyses of cream and butter fat.

1. *Statement of Articles of Fodder used during 1892 (Pounds).*

| 1892. | Wheat Bran. | Gluten Feed. | Maize Feed. | Cotton-seed Meal. | Hay. | Rowen. | Green Fodder Corn. | Corn Stover. | Corn Ensilage. | Green Rye. | Canada Peas and Oats. | Vetch. | Vetch and Oats. | Rape. | Serradella. | Sugar Beets. | Cabbages. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, . . | 523.50 | - | 523.50 | 523.50 | 570.00 | - | - | 714.00 | 3,768.00 | - | - | - | - | - | - | - | - |
| February, . | 516.00 | - | 516.00 | 516.00 | 870.00 | - | - | - | 6,292.00 | - | - | - | - | - | - | - | - |
| March, . . | 549.00 | 150.00 | 396.00 | 549.00 | 870.00 | 615.00 | - | - | 4,604.00 | - | - | - | - | - | - | 840.00 | - |
| April, . . | 450.00 | 450.00 | - | 450.00 | - | 2,250.00 | - | - | - | - | - | - | - | - | - | 2,250.00 | - |
| May, . . . | 465.00 | 465.00 | - | 465.00 | - | 1,855.00 | - | - | - | 850.00 | - | - | - | - | - | 1,500.00 | - |
| June, . . | 540.00 | 540.00 | - | 540.00 | - | 900.00 | - | - | - | 1,254.00 | 2,220.00 | - | 540.00 | - | - | - | - |
| July, . . | 558.00 | 558.00 | - | 558.00 | - | 930.00 | - | - | - | - | - | - | 6,776.00 | - | - | - | - |
| August, . . | 558.00 | 558.00 | - | 558.00 | - | 930.00 | 6,102.00 | - | - | - | - | 1,380.00 | - | 882.00 | - | - | 2,016.00 |
| September, . | 540.00 | 540.00 | - | 540.00 | - | 900.00 | 7,781.00 | - | - | - | - | - | - | 297.00 | 2,130.00 | - | - |
| October, . . | 558.00 | 558.00 | - | 558.00 | - | 270.00 | 1,119.00 | - | - | - | - | - | - | 162.00 | 1,008.00 | - | 180.00 |
| November, . | 540.00 | 540.00 | - | 540.00 | 2,575.00 | - | - | - | - | - | - | - | - | - | - | 1,980.00 | - |
| December, . | 558.00 | 558.00 | - | 558.00 | 315.00 | - | - | 2,159.00 | - | - | - | - | - | - | - | 540.00 | - |

1. *Statement of Articles of Fodder used during 1893 (Pounds).*

| 1893. | Wheat Bran. | Buffalo Gluten Feed. | Cotton-seed Meal. | New-process Linseed Meal. | Hay. | Rowen. | Green Fodder Corn. | Corn Stover. | Corn and Soja-bean Ensilage. | Soja-bean and Corn Ensilage. | Serradella and Hungarian Grass Ensilage. | Peas and Oats (Dry). | Vetch and Oats (Dry). | Vetch and Oats (Green). | Buckwheat (Green). | Vetch (Green). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, . . . | 489.00 | 489.00 | 442.00 | - | 1,080.00 | - | - | 742.50 | 2,968.50 | - | - | - | - | - | - | - |
| February, . . | 504.00 | 504.00 | 491.00 | - | 798.00 | - | - | - | 7,084.00 | - | - | - | - | - | - | - |
| March, . . . | 516.00 | 516.00 | 507.00 | - | 721.00 | - | - | - | 9,103.00 | - | - | - | - | - | - | - |
| April, . . . | 507.00 | 507.00 | 426.00 | - | 781.00 | - | - | - | 2,530.00 | 1,370.00 | 4,751.00 | - | - | - | - | - |
| May, . . . | 555.00 | 555.00 | 555.00 | - | 753.00 | - | - | - | - | 9,233.00 | - | - | 448.00 | - | - | - |
| June, . . . | 540.00 | 540.00 | 540.00 | - | - | 942.00 | - | - | - | - | - | 1,564.00 | 184.00 | - | - | - |
| July, . . . | 558.00 | 558.00 | 409.50 | 130.50 | - | 1,820.00 | - | - | - | - | - | - | - | 3,880.00 | - | - |
| August, . . . | 558.00 | 558.00 | - | 558.00 | - | 2,726.00 | - | - | - | - | - | - | - | - | 633.00 | 252.00 |
| September, . . | 531.00 | 531.00 | - | 519.00 | 264.00 | 636.00 | 948.00 | - | - | - | - | - | - | - | - | - |
| October, . . . | 558.00 | 558.00 | - | 558.00 | 1,757.00 | - | 7,818.00 | - | - | - | - | - | - | - | - | - |

## 2. *Record of Average Quality of Milk and of Fodder Rations (1892).*

| 1892. | Average Percentage of Solids in Milk. | Average Percentage of Fat in Milk. | Quarts of Milk required to make One Space of Cream. | Nutritive Ratio of Feed. | FEED CONSUMED (POUNDS) PER DAY. Wheat Bran. | Gluten Feed. | Maize Feed. | Cotton-seed Meal. | Hay. | Rowen. | Green Fodder Corn. | Corn Stover. | Corn Ensilage. | Green Rye. | Canada Peas and Oats. | Vetch and Oats. | Serradella. | Sugar Beets. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, | 13.75 | 4.55 | 1.73 | 1:4.63<br>- | 3.00<br>3.00 | -<br>- | 3.00<br>3.00 | 3.00<br>3.00 | -<br>5.00 | -<br>- | -<br>- | 12.06<br>- | -<br>32.00 | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- |
| February, | 13.24 | 4.36 | 1.70 | 1:4.64 | 3.00 | - | 3.00 | 3.00 | 5.00 | - | - | - | 32.00 | - | - | - | - | - |
| March, | 12.98 | 4.10 | 1.58 | 1:4.81 | 3.00 | - | 3.00 | 3.00 | 5.00 | - | - | - | 41.39 | - | - | - | - | - |
| April, | 13.09 | 4.01 | 1.72 | 1:4.48 | 3.00 | 3.00 | - | 3.00 | - | 15.00 | - | - | - | - | - | - | - | 15.00 |
| May, | 13.00 | 3.92 | 1.77 | 1:4.80 | 3.00 | 3.00 | - | 3.00 | - | 15.00 | - | - | - | - | - | - | - | 15.00 |
| June, | 13.43 | 4.28 | 2.09 | 1:3.78<br>1:3.70 | 3.00<br>3.00 | 3.00<br>3.00 | -<br>- | 3.00<br>3.00 | -<br>- | 5.00<br>5.00 | -<br>- | -<br>- | -<br>- | 16.22<br>- | -<br>27.50 | -<br>- | -<br>- | -<br>- |
| July, | 12.80 | 3.73 | 1.82 | 1:3.76 | 3.00 | 3.00 | - | 3.00 | - | 5.00 | - | - | - | - | - | 37.71 | - | - |
| August, | 12.30 | 3.50 | 2.08 | 1:5.00 | 3.00 | 3.00 | - | 3.00 | - | 5.00 | 50.00 | - | - | - | - | - | - | - |
| September, | 12.55 | 3.66 | 1.88 | 1:5.70<br>1:4.60 | 3.00<br>3.00 | 3.00<br>3.00 | -<br>- | 3.00<br>3.00 | -<br>- | 5.00<br>5.00 | 70.00<br>30.00 | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>20.00 | -<br>- |
| October, | 13.17 | 3.77 | 1.85 | 1:5.22<br>1:4.50 | 3.00<br>3.00 | 3.00<br>3.00 | -<br>- | 3.00<br>3.00 | -<br>15.00 | -<br>- | 30.00<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | 20.00<br>- | -<br>- |
| November, | 13.45 | 3.85 | 1.86 | 1:4.90 | 3.00 | 3.00 | - | 3.00 | 14.19 | - | - | - | - | - | - | - | - | 15.00 |
| December, | 13.66 | 4.33 | 1.80 | 1:4.80 | 3.00 | 3.00 | - | 3.00 | - | - | - | 15.00 | - | - | - | - | - | 15.00 |
| Averages, | 13.12 | 4.01 | 1.82 | 1:4.95 | | | | | | | | | | | | | | |

## 2. *Record of Average Quality of Milk and of Fodder Rations (1893).*

| 1893. | Average Percentage of Solids in Milk. | Average Percentage of Fat in Milk. | Quarts of Milk required to make One Space of Cream. | Nutritive Ratio of Feed. | FEED CONSUMED (POUNDS) PER DAY. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Wheat Bran. | Gluten Feed. | Cotton-seed Meal. | New-process Linseed Meal. | Hay. | Rowen. | Green Fodder Corn. | Corn Stover. | Corn and Soja-bean Ensilage. | Soja-bean and Corn Ensilage. | Serradella and Hungarian Grass Ensilage. | Peas and Oats (Dry). | Vetch and Oats (Dry). | Vetch and Oats (Green). |
| January, . . . . | 13.80 | 4.77 | 1.66 | 1:4.80<br>1:4.00 | 3.00<br>3.00 | 3.00<br>3.00 | 3.00<br>3.00 | -<br>- | -<br>9.47 | -<br>- | -<br>- | 15.00<br>- | -<br>22.48 | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- |
| February, . . . | 13.82 | 4.73 | 1.70 | 1:4.80 | 3.00 | 3.00 | 3.00 | - | 4.75 | - | - | - | 42.16 | - | - | - | - | - |
| March, . . . . | 14.01 | 4.71 | 1.75 | 1:4.80 | 3.00 | 3.00 | 3.00 | - | 4.00 | - | - | - | 46.68 | - | - | - | - | - |
| April, . . . . | 13.73 | 4.67 | 1.93 | 1:4.90<br>1:4.50 | 3.00<br>3.00 | 3.00<br>3.00 | 3.00<br>1.00 | -<br>- | 4.00<br>4.00 | -<br>- | -<br>- | -<br>- | 50.00<br>- | -<br>- | -<br>50.00 | -<br>- | -<br>- | -<br>- |
| May, . . . . . | 13.74 | 4.51 | 1.94 | 1:5.00<br>1:3.50 | 3.00<br>3.00 | 3.00<br>3.00 | 3.00<br>3.00 | -<br>- | 4.00<br>- | -<br>- | -<br>- | -<br>- | -<br>- | 54.95<br>- | -<br>- | -<br>- | -<br>12.50 | -<br>- |
| June, . . . . | 13.81 | 4.42 | 1.83 | 1:3.60<br>1:4.40 | 3.00<br>3.00 | 3.00<br>3.00 | 3.00<br>3.00 | -<br>- | -<br>- | -<br>16.00 | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | 15.60<br>- | -<br>- | -<br>- |
| July, . . . . | 13.67 | 4.52 | 1.81 | 1:4.40<br>1:3.79 | 3.00<br>3.00 | 3.00<br>3.00 | 3.00<br>3.00 | -<br>- | -<br>- | 16.00<br>4.00 | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>40.00 |
| August, . . . . | 13.64 | 4.52 | 2.00 | 1:4.50 | 3.00 | 3.00 | - | 3.00 | - | 18.00 | - | - | - | - | - | - | - | - |
| September, . . . | 13.96 | 4.53 | 1.98 | 1:4.90 | 3.00 | 3.00 | - | 3.00 | - | 4.00 | 46.00 | - | - | - | - | - | - | - |
| October, . . . . | 14.01 | 4.84 | 1.99 | 1:4.50<br>1:3.79 | 3.00<br>3.00 | 3.00<br>3.00 | -<br>- | 3.00<br>3.00 | 17.60<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>- | -<br>16.00 | -<br>- |
| Averages, . . . | 13.82 | 4.62 | 1.86 | 1:4.38 | | | | | | | | | | | | | | |

### 3. *Value of Cream at Creamery Basis of Valuation.*

| | Total Cost of Feed consumed. | Total Value of Fertilizing Constituents of Food consumed. | Value of Fertilizing Constituents lost in Cream. | Net Cost of Feed for Production of Cream. | Value of Cream produced. |
|---|---|---|---|---|---|
| **1892.** | | | | | |
| January, . . . . | $31 07 | $17 51 | $0 55 | $14 11 | $34 64 |
| February, . . . | 34 38 | 18 36 | 0 62 | 16 64 | 38 95 |
| March, . . . . | 38 50 | 20 95 | 0 76 | 18 31 | 45 04 |
| April, . . . . | 38 47 | 21 04 | 0 65 | 18 08 | 36 59 |
| May, . . . . | 35 23 | 20 13 | 0 67 | 15 77 | 31 65 |
| June, . . . . | 31 28 | 19 44 | 0 57 | 12 41 | 27 50 |
| July, . . . . | 36 11 | 22 80 | 0 58 | 13 89 | 28 69 |
| August, . . . . | 39 94 | 23 95 | 0 56 | 16 57 | 32 22 |
| September, . . . | 38 95 | 22 93 | 0 55 | 16 57 | 33 72 |
| October, . . . . | 40 12 | 22 14 | 0 57 | 18 55 | 34 84 |
| November, . . . | 43 33 | 21 29 | 0 45 | 22 49 | 31 00 |
| December, . . . | 28 91 | 17 03 | 0 41 | 12 29 | 29 02 |
| Averages, . . . | $36 36 | $20 63 | $0 57 | $16 31 | $33 65 |
| **1893.** | | | | | |
| January, . . . . | $30 41 | $22 81 | $0 67 | $7 27 | $41 69 |
| February, . . . | 32 44 | 20 05 | 0 80 | 13 19 | 49 39 |
| March, . . . . | 35 07 | 24 91 | 0 91 | 11 07 | 56 32 |
| April, . . . . | 33 59 | 25 42 | 0 70 | 8 87 | 41 24 |
| May, . . . . | 40 29 | 27 98 | 0 70 | 13 01 | 38 95 |
| June, . . . . | 38 27 | 28 48 | 0 62 | 10 41 | 32 80 |
| July, . . . . | 36 81 | 26 34 | 0 61 | 10 58 | 31 57 |
| August, . . . . | 40 31 | 26 74 | 0 60 | 14 17 | 31 32 |
| September, . . . | 33 61 | 18 99 | 0 55 | 15 17 | 32 88 |
| October, . . . . | 41 57 | 28 68 | 0 61 | 13 50 | 34 84 |
| Averages, . . . | $36 24 | $25 08 | $0 68 | $11 72 | $39 10 |

### 4. *Cost of Skim-milk on the Basis of Three Cents per Quart for Whole Milk.*

| | Quarts of Milk produced. | Spaces of Cream. | Quarts of Cream (One Quart equals 3.4 Spaces). | Quarts of Skim-milk. | Value of Cream per Space (Cents). | Value of Cream per Quart of Milk (Cents). | Total Value of Cream. | Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart). | Total Cost of Skim-milk. |
|---|---|---|---|---|---|---|---|---|---|
| **1892.** | | | | | | | | | |
| January, | 1,460.3 | 845.0 | 248.5 | 1,211.8 | 4.10 | 2.38 | $34 64 | 0.75 | $9 16 |
| February, | 1,612.4 | 950.0 | 279.4 | 1,333.0 | 4.10 | 2.42 | 38 95 | 0.71 | 9 42 |
| March, | 1,818.0 | 1,155.0 | 340.0 | 1,478.0 | 3.90 | 2.45 | 45 04 | 0.65 | 9 50 |
| April, | 1,704.4 | 989.0 | 290.9 | 1,413.5 | 3.70 | 2.14 | 36 59 | 1.03 | 14 54 |
| May, | 1,806.7 | 1,021.0 | 300.0 | 1,506.7 | 3.10 | 1.73 | 31 65 | 1.50 | 22 55 |
| June, | 1,818.5 | 873.0 | 256.8 | 1,561.7 | 3.15 | 1.51 | 27 50 | 1.73 | 27 05 |
| July, | 1,602.8 | 883.0 | 260.0 | 1,342.8 | 3.25 | 1.78 | 28 69 | 1.44 | 19 40 |
| August, | 1,765.8 | 848.0 | 249.4 | 1,516.4 | 3.80 | 1.80 | 32 22 | 1.36 | 20 76 |
| September, | 1,581.4 | 843.0 | 248.0 | 1,333.4 | 4.00 | 2.12 | 33 72 | 1.03 | 13 71 |
| October, | 1,614.7 | 871.0 | 256.2 | 1,358.5 | 4.00 | 2.16 | 34 84 | 1.00 | 13 61 |
| November, | 1,408.7 | 756.0 | 222.3 | 1,186.4 | 4.10 | 2.20 | 31 00 | 0.94 | 11 26 |
| December, | 1,232.0 | 691.0 | 203.2 | 1,028.8 | 4.20 | 2.35 | 29 02 | 0.64 | 7 94 |
| Averages, | 1,618.8 | 893.8 | 262.8 | 1,357.6 | 3.78 | 2.09 | $33 66 | 1.07 | $14 83 |
| **1893.** | | | | | | | | | |
| January, | 1,625.2 | 981.0 | 288.5 | 1,336.5 | 4.25 | 2.57 | $41 69 | 0.53 | $7 06 |
| February, | 2,007.4 | 1,176.0 | 345.9 | 1,651.5 | 4.20 | 2.46 | 49 39 | 0.66 | 10 83 |
| March, | 2,332.5 | 1,341.0 | 394.4 | 1,938.1 | 4.20 | 2.41 | 56 32 | 0.70 | 13 65 |
| April, | 2,008.7 | 1,031.0 | 303.2 | 1,705.5 | 4.00 | 2.05 | 41 24 | 1.11 | 19 02 |
| May, | 1,997.6 | 1,025.0 | 301.5 | 1,696.1 | 3.80 | 1.98 | 38 95 | 1.24 | 20 97 |
| June, | 1,668.6 | 911.0 | 267.9 | 1,400.7 | 3.60 | 1.96 | 32 80 | 1.23 | 17 25 |
| July, | 1,632.2 | 902.0 | 265.3 | 1,366.9 | 3.50 | 1.93 | 31 57 | 1.16 | 17 39 |
| August, | 1,743.9 | 870.0 | 258.9 | 1,495.0 | 3.60 | 1.61 | 31 32 | 1.41 | 20 99 |
| September, | 1,605.6 | 822.0 | 241.8 | 1,363.8 | 4.00 | 2.04 | 32 88 | 1.12 | 15 28 |
| October, | 1,830.9 | 901.0 | 265.0 | 1,565.9 | 4.00 | 1.97 | 34 84 | 1.20 | 18 89 |
| Averages, | 1,845.3 | 996.0 | 293.2 | 1,552.0 | 3.91 | 2.09 | $39 10 | 1.03 | $16 13 |

### 5. *What the Creamery Records Show.*

1. The nutritive ratio of the feed varied in 1892 from 1 : 3.70 to 1 : 5.70, with an average of 1 : 4.95; in 1893 from 1 : 3.50 to 1 : 5.00, with an average of 1 : 4.38.

2. The average monthly percentage of fat in the milk varied in 1892 from 3.50 to 4.55, with an average of 4.01; in 1893, from 4.42 to 4.84, with an average of 4.62.

3. The average monthly percentage of total solids varied in 1892 from 12.30 to 13.75, with an average of 13.12; in 1893, from 13.64 to 14.01, with an average of 13.82.

4. The relation of fat to solids not fat in 1892 was 1:2.29, while in 1893 it was 1 : 1.99.

5. The total cost of feed for one quart of cream amounted in 1892 to 13.84 cents and in 1893 to 12.36 cents.

6. The net cost of feed for one quart of cream amounted in 1892 to 6.21 cents and in 1893 to 4.00 cents.

7. The value received for one space of cream varied in 1892 from 3.10 to 4.20 cents, with an average of 3.78; in 1893, from 3.50 to 4.25, with an average of 3.91 cents; which amounted per quart (average) in 1892 to 12.85 cents, and in 1893 to 13.29 cents.

8. The number of quarts of milk required to produce one space of cream in 1892 was 1.81 and in 1893 1.85; or 6.16 quarts of whole milk to produce one quart of cream in 1892, and 6.29 quarts of whole milk to produceone quart of cream in 1893.

9. The net cost of feed per quart of cream averaged in 1892 6.21 cents and in 1893 4.00 cents. Received per quart of cream in 1892 12.85 cents and in 1893 13.34 cents, thereby securing a profit of 6.64 cents per quart in 1892 and 9.34 cents in 1893.

For further details concerning results in preceding years, see ninth annual report, pages 76 to 82, and tenth annual report, pages 48 to 55.

Our average statements for the current year apply in each case to only ten months, due to the fact that the financial settlement is made with our local creamery two months after the cream is furnished.

### 6. *Creamery Record, 1892–93. — Analyses of Cream and Butter Fat.*

| FEEDING PERIODS. | DATE OF SAMPLING. | ANALYSIS OF CREAM. | | | ANALYSIS OF FAT. | | AVERAGE DAILY FODDER RATIONS. |
|---|---|---|---|---|---|---|---|
| | | Solids. | Fat. | Solids not Fat. | Volatile Acids. | Non-volatile Acids. | |
| I. | Oct. 18, | 25.63 | 16.00 | 9.63 | – | – | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cottonseed meal, 15 pounds hay. |
| II. | Dec. 3, | 25.28 | 16.90 | 8.38 | – | – | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cottonseed meal, 15 pounds hay, 15 pounds sugar beets. |
| III. | Dec. 23, | 25.55 | 17.00 | 8.55 | – | – | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cottonseed meal, 15.9 pounds corn stover. |
| IV. | Jan. 19, | 28.52 | 20.66 | 7.86 | 5.63 | 88.75 | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cottonseed meal, 4 pounds hay, 48 pounds corn and soja-bean ensilage. |
| | Jan. 25, | 26.30 | 18.00 | 8.30 | 5.77 | 87.45 | |
| | Jan. 30, | 27.50 | 18.83 | 8.67 | 5.57 | 87.42 | |
| | Feb. 9, | 27.03 | 18.55 | 8.48 | 5.73 | 87.00 | |
| | Feb. 15, | 27.19 | 19.55 | 7.64 | 5.48 | 87.33 | |
| | Feb. 28, | 28.23 | 20.23 | 8.00 | 5.98 | 86.80 | |
| | March 6, | 29.17 | 21.20 | 7.97 | 5.57 | 88.30 | |
| | March 15, | 30.00 | 22.25 | 7.75 | 5.39 | 87.15 | |
| | March 21, | 27.10 | 19.13 | 7.97 | 5.48 | 87.46 | |
| | March 28, | 26.19 | 18.44 | 7.75 | 5.75 | 86.55 | |
| | April 4, | 26.66 | 18.80 | 7.86 | 5.91 | 86.90 | |
| V. | May 3, | 27.11 | 19.01 | 8.10 | 5.81 | 87.71 | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton seed meal, 4 pounds hay, 49.5 pounds soja-bean and corn ensilage. |
| | May 17, | 25.45 | 17.85 | 7.60 | 5.45 | 87.47 | |
| | May 23, | 27.34 | 19.97 | 7.37 | 5.52 | 87.81 | |
| VI. | June 8, | 25.18 | 18.02 | 7.17 | 5.04 | 88.49 | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cottonseed meal, 14.64 pounds hay of peas and oats. |
| | June 14, | 27.31 | 19.08 | 8.23 | 5.38 | 87.45 | |
| | June 22, | 25.53 | 18.56 | 6.97 | 4.95 | 88.17 | |
| VII. | June 28, | 29.87 | 22.48 | 7.39 | 4.79 | 87.57 | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cottonseed meal, 16.62 pounds rowen. |
| | July 5, | 24.86 | 16.85 | 8.01 | 5.72 | 88.25 | |

### 6. *Creamery Record, 1893. — Analyses of Cream and Butter Fat.*

| FEEDING PERIODS. | DATE OF SAMPLING. | ANALYSIS OF CREAM. | | | ANALYSIS OF FAT. | | AVERAGE DAILY FODDER RATIONS. |
|---|---|---|---|---|---|---|---|
| | | Solids. | Fat. | Solids not Fat. | Volatile Acids. | Non-volatile Acids. | |
| I. | July 14, | 31.60 | 23.99 | 7.61 | – | – | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 4 pounds rowen, 39.60 pounds vetch and oats. |
| | July 19, | 30.56 | 22.63 | 7.93 | 5.34 | 88.15 | |
| II. | Aug. 12, | 27.85 | 19.82 | 8.03 | 5.24 | 87.00 | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds linseed meal, 17.76 pounds rowen. |
| | Aug. 17, | 32.78 | 24.78 | 8.00 | 4.77 | 88.20 | |
| | Aug. 22, | 32.44 | 25.00 | 7.44 | – | – | |
| III. | Sept. 5, | 27.41 | 20.30 | 7.11 | 4.82 | 88.17 | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds linseed meal, 4 pounds rowen, 51.29 pounds corn fodder. |
| | Sept. 12, | 24.81 | 16.79 | 8.02 | 5.50 | – | |
| | Sept. 29, | 24.89 | 16.23 | 8.61 | 5.52 | 86.93 | |
| IV. | Oct. 3, | 24.63 | 16.01 | 8.62 | 5.88 | 86.79 | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds linseed meal, 18 pounds hay. |
| | Oct. 13, | 26.87 | 17.75 | 9.12 | 5.50 | 87.04 | |
| | Oct. 20, | 26.29 | 18.15 | 8.14 | 5.27 | 87.64 | |
| V. | Oct. 25, | 26.19 | 17.85 | 8.34 | 4.87 | 88.27 | 3 pounds wheat bran, 3 pounds gluten feed, 3 pounds linseed meal, 16 pounds hay of vetch and oats. |
| | Oct. 31, | 24.71 | 16.58 | 8.13 | 5.20 | 87.02 | |

## II.

# FOURTH FEEDING EXPERIMENT WITH STEERS.

## 1892–93.

### General Description.

The experiment here described is a continuation of those published in our previous reports.

Two grades Shorthorn steers, yearlings, weighing about six hundred pounds each, were used in the experiment. They were quite thin when first received, and cost 3.5 cents per pound of live weight.

The coarse foods fed were raised upon the station grounds, and consisted principally of corn ensilage, corn stover, hay, green rye and a small quantity of roots.

The corn for ensilage was cut just as the kernels were glazing. The corn stover was the corn plant remaining after the fully matured ears had been removed.

The grains used were either equal weight parts of wheat bran and Chicago maize feed or wheat bran and Buffalo gluten feed.

The quantity of coarse fodders fed depended in all cases upon the individual appetite of the animals.

The animals were fed and watered twice each day, between five and six o'clock in the morning and at five in the afternoon, one-half of the food being given at each time.

Two distinct feeding periods are described, namely, the first winter and spring seasons and the autumn and second winter seasons.

### Objects of the Experiment.

The objects of the experiment were threefold : —

*I. To ascertain, if possible, those rations,* i. e., *combinations of food, that would produce the largest growth for the least outlay of money.*

*II. To secure facts relating to the actual cost of beef production in Massachusetts under existing local conditions.*

*III. To compare the relative merits and cost of pasture* vs. *soiling during the summer season.*

## 1. FEEDING RECORD OF FIRST WINTER AND SPRING SEASONS.

### *Dec. 1, 1891, to June 12, 1892.*

[Coarse fodders: hay, corn ensilage, corn stover, green rye, turnips, mangolds and sugar beets; grains: wheat bran, Chicago maize feed and Buffalo gluten feed.]

*Local Market Cost, per Ton, of the Various Articles of Fodder used.*

| | |
|---|---|
| Wheat bran, | $22 00 |
| Chicago maize feed, | 25 00 |
| Buffalo gluten feed, | 23 00 |
| Hay, | 15 00 |
| Dent corn ensilage,* | 2 50 |
| Sweet corn ensilage, | 2 50 |
| Dent corn stover,* | 5 00 |
| Green rye, | 2 50 |
| Turnips, | 2 50 |
| Mangolds, | 4 00 |
| Sugar beets, | 5 00 |

* Pride of the North.

*Analyses of Fine Feed used.*

| FODDER ANALYSES. | Wheat Bran. | Chicago Maize Feed. | Buffalo Gluten Feed. |
|---|---|---|---|
| Moisture at 100° C., | 10.09 | 8.70 | 7.65 |
| Dry matter, | 89.91 | 91.30 | 92.35 |
| | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | |
| Crude ash, | 6.62 | 0.78 | 0.86 |
| " cellulose, | 11.91 | 7.97 | 5.42 |
| " fat, | 4.76 | 7.37 | 13.23 |
| " protein, | 17.55 | 27.75 | 25.95 |
| Non-nitrogenous extract matter, | 59.16 | 56.33 | 54.54 |
| | 100.00 | 100.00 | 100.00 |

## *Fertilizing Constituents.*

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

| FERTILIZING ANALYSES. | Wheat Bran. | Chicago Maize Feed. | Buffalo Gluten Feed. |
|---|---|---|---|
| Moisture, | 10.09 | 8.70 | 7.65 |
| Nitrogen, | 2.52 | 4.03 | 3.88 |
| Phosphoric acid, | 2.85 | 0.30 | 0.30 |
| Potassium oxide, | 1.63 | 0.045 | 0.045 |
| Valuation per 2,000 pounds, | $12 16 | $12 41 | $12 41 |
| Manurial value obtainable, | 11 18 | 11 41 | 11 00 |

## *Analyses of Coarse Fodders used.*

| FODDER ANALYSES. | Hay. | Dent Corn Ensilage. | Sweet Corn Ensilage. | Dent Corn Stover. | Green Rye. | Turnips. | Mangolds. | Sugar Beets. |
|---|---|---|---|---|---|---|---|---|
| Moisture at 100° C., | 9.72 | 79.92 | 84.30 | 20.10 | 62.11 | 90.21 | 87.75 | 85.27 |
| Dry matter, | 90.28 | 20.08 | 15.70 | 79.90 | 37.89 | 9.79 | 12.25 | 14.73 |
|  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* |  |  |  |  |  |  |  |  |
| Crude ash, | 6.43 | 4.99 | 6.32 | 6.12 | 5.27 | 8.47 | 9.06 | 5.95 |
| " cellulose, | 32.28 | 27.19 | 29.32 | 33.72 | 21.52 | 11.23 | 7.94 | 6.49 |
| " fat, | 2.49 | 3.29 | 7.36 | 2.51 | 2.46 | 1.74 | 0.88 | 0.66 |
| " protein, | 9.54 | 8.29 | 7.86 | 7.75 | 5.38 | 10.12 | 10.37 | 10.97 |
| Non-nitrogenous extract matter, | 49.26 | 56.24 | 49.14 | 49.90 | 65.57 | 68.44 | 71.75 | 75.93 |
|  | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

## *Fertilizing Constituents.*

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

| FERTILIZER ANALYSES. | Hay. | Dent Corn Ensilage. | Sweet Corn Ensilage. | Dent Corn Stover. | Green Rye. | Turnips. | Mangolds. | Sugar Beets. |
|---|---|---|---|---|---|---|---|---|
| Moisture, | 9.72 | 79.92 | 84.30 | 20.11 | 62.11 | 90.21 | 87.75 | 85.27 |
| Nitrogen, | 1.38 | 0.27 | 0.20 | 0.99 | 0.327 | 0.178 | 0.203 | 0.26 |
| Phosphoric acid, | 0.36 | 0.33 | 0.41 | 1.40 | 0.734 | 0.385 | 0.383 | 0.48 |
| Potassium oxide, | 1.57 | 0.14 | 0.089 | 0.29 | 0.15 | 0.104 | 0.093 | 0.10 |
| Valuation per 2,000 pounds, | $5 95 | $1 26 | $1 06 | $4 55 | $1 80 | $0 99 | $1 06 | $1 32 |
| Manurial value obtainable, | 5 47 | 1 16 | 0 97 | 4 19 | 1 66 | 0 91 | 0 97 | 1 21 |

### *Average Composition of the Daily Fodder Rations used during the Seven Successive Feeding Periods.*

*(First Winter and Spring Seasons, 1891–92.)*

I.

*December 1 to December 21.*

| | |
|---|---|
| Wheat bran, | 2.5 lbs. |
| Chicago maize feed, | 2.5 " |
| Hay, | 8 " |
| Turnips, | 15 " |
| Nutritive ratio, | 1:5.94 |
| Total cost, | 13.87 cts. |
| Manurial value obtainable, | 5.44 " |
| Net cost, | 8.43 " |

II.

*December 26 to January 12.*

| | |
|---|---|
| Wheat bran, | 2.5 lbs. |
| Chicago maize feed, | 2.5 " |
| Hay, | 8 " |
| Mangolds, | 15 " |
| Nutritive ratio, | 1:6.06 |
| Total cost, | 14.87 cts. |
| Manurial value obtainable, | 5.64 " |
| Net cost, | 9.23 " |

III.

*January 25 to February 21.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Chicago maize feed, | 3 " |
| Dent corn ensilage, | 35 " |
| Nutritive ratio, | 1:5.4 |
| Total cost, | 11.42 cts. |
| Manurial value obtainable, | 5.39 " |
| Net cost, | 6.03 " |

IV.

*February 29 to March 22.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Chicago maize feed, | 3 " |
| Sweet corn ensilage, | 47 " |
| Nutritive ratio, | 1:5.92 |
| Total cost, | 12.92 cts. |
| Manurial value obtainable, | 5.64 " |
| Net cost, | 7.28 " |

V.

*March 28 to April 19.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Chicago maize feed, | 3 " |
| Dent corn stover, | 10 " |
| Nutritive ratio, | 1:5.65 |
| Total cost, | 9.55 cts. |
| Manurial value obtainable, | 5.48 " |
| Net cost, | 4.07 " |

VI.

*April 26 to May 20.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Hay, | 10 " |
| Sugar beets, | 12 " |
| Nutritive ratio, | 1:5.95 |
| Total cost, | 17.55 cts. |
| Manurial value obtainable, | 6.75 " |
| Net cost, | 10.80 " |

VII.

*June 1 to June 12.*

| | |
|---|---|
| Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " |
| Green rye, | 23 " |
| Nutritive ratio, | 1:6.9 |
| Total cost, | 9.62 cts. |
| Manurial value obtainable, | 5.33 " |
| Net cost, | 4.29 " |

### *Points to be Noticed in Above.*

1. The actual composition of the different rations and the general proportion which the nitrogenous matter bears to the non-nitrogenous, *i. e.*, the nutritive ratio.

2. Notice how both the total and net cost of the different rations differ, and that wherever a considerable quantity of hay is fed the cost of the ration increases.

### *Summary of Cost of the Above-stated Average Daily Fodder Rations.*

[Cents.]

| | Feeding Periods. | | | | | | |
|---|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. | VI. | VII. |
| Total cost, . . . . . . . . | 13.87 | 14.87 | 11.42 | 12.92 | 9.55 | 17.55 | 9.62 |
| Manurial value obtainable,* . . . | 5.44 | 5.64 | 5.39 | 5.64 | 5.48 | 6.75 | 5.33 |
| Net cost, . . . . . . . . | 8.43 | 9.23 | 6.03 | 7.28 | 4.07 | 10.80 | 4.29 |

* Allowing ninety-two per cent. of the fertilizing ingredients of the feed to be recovered in the manure.

### *Gain required per Day in Pounds of Live Weight to cover Cost of Feed.*

| | Feeding Periods. | | | | | | |
|---|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. | VI. | VII. |
| On total cost, . . | 3.26 | 3.50 | 2.69 | 3.04 | 2.25 | 4.10 | 2.27 |
| On net cost, . . | 2.00 | 2.17 | 1.42 | 1.71 | 0.96 | 2.54 | 1.00 |

### *Live Weight actually produced per Day.*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2.21 | 1.77 | 1.78 | 1.15 | 0.70 | 2.00 | 0.87 |

### *Cost of Feed per Pound of Live Weight gained.*

[Cents ]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total cost, . . . | 6.30 | 8.40 | 6.41 | 11.24 | 13.64 | 8.77 | 11.06 |
| Net cost, . . . | 3.83 | 5.20 | 3.38 | 6.33 | 5.81 | 5.40 | 4.96 |

### *Remarks.*

These figures show that in no case have the animals gained enough in live weight to cover the total cost of the food consumed, but the weight gained was nearly sufficient to cover the net cost of the feed.

Considering the merits of the different rations as far as their relative cost and productive capacity are concerned, the results are at least instructive.

Notice, first, that the larger the amount of hay fed the higher the cost of the daily ration. In this experiment, however, a moderate amount of hay in combination with roots and grains has produced beef at a fairly low price. Ration number III., consisting of ensilage and grains, has also given very favorable results. In the latter case the total cost of feed per pound of live weight gained was 6.35 cents and the net cost 3.38 cents. Many experiments have demonstrated the fact that corn ensilage, when fed in combination with concentrated feeds high in protein, produces beef at as low a cost as any other known coarse fodder article, and it proves itself an excellent fodder for winter feeding.

### *Steer No. 1.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | | | | | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). | Dry Matter required to produce One Pound of Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Chicago Maize Feed. | Buffalo Gluten Feed. | Hay. | Dent Corn Ensilage. | Sweet Corn Ensilage. | Dent Corn Stover. | Green Rye. | Turnips. | Mangolds. | Sugar Beets. | | | | | | |
| **1891-92.** | | | | | | | | | | | | | | | | | |
| Dec. 1 to Dec. 21, | 2.5 | 2.5 | - | 9.0 | - | - | - | - | 15.0 | - | - | 14.13 | 1:5.94 | 588 | 650 | 3.00 | 4.71 |
| Dec. 26 to Jan. 12, | 2.5 | 2.5 | - | 8.7 | - | - | - | - | - | 13.8 | - | 14.06 | 1:6.06 | 650 | 695 | 2.00 | 7.03 |
| Jan. 25 to Feb. 21, | 3.0 | 3.0 | - | - | 35.0 | - | - | - | - | - | - | 12.44 | 1:5.40 | 700 | 750 | 1.80 | 6.91 |
| Feb. 29 to March 22, | 3.0 | 3.0 | - | - | - | 44.0 | - | - | - | - | - | 12.34 | 1:5.90 | 750 | 780 | 1.30 | 9.50 |
| March 28 to April 19, | 3.0 | 3.0 | - | - | - | - | 9.0 | - | - | - | - | 12.64 | 1:5.65 | 774 | 785 | 0.50 | 25.30 |
| April 26 to May 20, | 3.0 | - | 3.0 | 10.0 | - | - | - | - | - | - | 12.0 | 16.30 | 1:5.95 | 812 | 860 | 2.00 | 8.15 |
| June 1 to June 12, | 3.0 | - | 3.0 | - | - | - | - | 24.0 | - | - | - | 14.56 | 1:6.90 | 870 | 885 | 1.25 | 11.64 |

| | Pounds. |
|---|---|
| Live weight of animal at the beginning of the experiment, | 588.00 |
| Live weight of animal at the close of the experiment, | 885.00 |
| Live weight gained during the experiment, | 297.00 |
| Average gain in weight per day, | 1.52 |

### *Steer No. 2.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | | | | | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). | Dry Matter required to produce One Pound of Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Chicago Maize Feed. | Buffalo Gluten Feed. | Hay. | Dent Corn Ensilage. | Sweet Corn Ensilage. | Dent Corn Stover. | Green Rye. | Turnips. | Mangolds. | Sugar Beets. | | | | | | |
| **1891-92.** | | | | | | | | | | | | | | | | | |
| Dec. 1 to Dec. 21, | 2.5 | 2.5 | - | 7.3 | - | - | - | - | 15.0 | - | - | 12.59 | 1:5.94 | 600 | 631 | 1.50 | 8.40 |
| Dec. 26 to Jan. 12, | 2.5 | 2.5 | - | 8.9 | - | - | - | - | - | 13.8 | - | 13.42 | 1:6.06 | 649 | 683 | 1.55 | 8.70 |
| Jan. 25 to Feb. 21, | 3.0 | 3.0 | - | - | 35.0 | - | - | - | - | - | - | 12.44 | 1:5.40 | 700 | 750 | 1.80 | 7.00 |
| Feb. 29 to March 22, | 3.0 | 3.0 | - | - | - | 53.0 | - | - | - | - | - | 13.76 | 1:5.92 | 776 | 800 | 1.00 | 13.76 |
| March 28 to April 19, | 3.0 | 3.0 | - | - | - | - | 9.0 | - | - | - | - | 12.64 | 1:5.65 | 770 | 792 | 1.00 | 12.64 |
| April 26 to May 20, | 3.0 | - | 3.0 | 10.0 | - | - | - | - | - | - | 12.0 | 16.30 | 1:5.95 | 825 | 874 | 2.00 | 8.15 |
| June 1 to June 12, | 3.0 | - | 3.0 | - | - | - | - | 22.5 | - | - | - | 15.02 | 1:6.90 | 865 | 871 | 0.50 | 30.04 |

| | Pounds. |
|---|---|
| Live weight of animal at the beginning of the experiment, | 600.00 |
| Live weight of animal at the close of the experiment, | 871.00 |
| Live weight gained during the experiment, | 271.00 |
| Average gain in weight per day, | 1.39 |

## 2. Feeding Record of Autumn and Second Winter Seasons.

### *Sept. 5, 1892, to Feb. 28, 1893.*

[Corn fodders: green fodder corn, green serradella, corn stover and corn and soja-bean ensilage; grains: wheat bran and Buffalo gluten feed.]

*Local Market Cost per Ton of the Various Articles of Fodder used.*

| | |
|---|---|
| Wheat bran, | $20 00 |
| Buffalo gluten feed, | 21 00 |
| Fodder corn (green), | 2 50 |
| Serradella (green), | 2 75 |
| Corn stover, | 5 00 |
| Corn and soja-bean ensilage, | 2 75 |

*Analyses of the Various Articles of Fodder used.*

| Fodder Analyses. | Wheat Bran. | Buffalo Gluten Feed. | Fodder Corn. | Serradella. | Corn Stover. | Corn and Soja-bean Ensilage. |
|---|---|---|---|---|---|---|
| Moisture at 100° C., | 8.71 | 7.18 | 68.53 | 82.03 | 14.66 | 77.77 |
| Dry matter, | 91.29 | 92.82 | 31.47 | 17.97 | 85.34 | 22.23 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | | |
| Crude ash, | 7.08 | 0.84 | 5.68 | 9.59 | 5.49 | 9.48 |
| " cellulose, | 12.10 | 7.50 | 23.00 | 26.28 | 37.57 | 26.63 |
| " fat, | 5.64 | 12.75 | 2.81 | 2.59 | 1.82 | 3.75 |
| " protein, | 17.73 | 26.28 | 6.22 | 15.13 | 4.00 | 7.91 |
| Non-nitrogenous extract matter, | 57.45 | 52.63 | 62.30 | 46.41 | 51.02 | 52.23 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

*Fertilizing Constituents.*

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

| Fertilizer Analyses. | Wheat Bran. | Buffalo Gluten Feed. | Fodder Corn. | Serradella. | Corn Stover. | Corn and Soja-bean Ensilage. |
|---|---|---|---|---|---|---|
| Moisture, | 8.71 | 7.18 | 68.53 | 82.03 | 14.66 | 77.77 |
| Nitrogen, | 2.42 | 4.25 | 0.31 | 0.43 | 0.55 | 0.32 |
| Phosphoric acid, | 2.85 | 0.30 | 0.05 | 1.26 | 0.23 | 0.12 |
| Potassium oxide, | 1.63 | 0.04 | 0.15 | 0.38 | 1.84 | 0.48 |
| Valuation per 2,000 pounds, | $11 86 | $13 13 | $1 12 | $1 78 | $3 55 | $1 52 |
| Manurial value obtainable, | 10 90 | 12 07 | 1 03 | 1 63 | 3 26 | 1 40 |

## *Average Composition of the Daily Fodder Rations used during the Four Successive Feeding Periods.*

*(Autumn and Second Winter Seasons, 1892–93.)*

| I. | | II. | |
|---|---|---|---|
| *September 5 to September 12.* | | *September 17 to September 28.* | |
| Wheat bran, | 3 lbs. | Wheat bran, | 3 lbs. |
| Buffalo gluten feed, | 3 " | Buffalo gluten feed, | 3 " |
| Fodder corn, | 70 " | Fodder corn, | 40 " |
| Nutritive ratio, | 1:8.70 | Serradella, | 20 " |
| Total cost, | 14.90 cts. | Nutritive ratio, | 1:6 60 |
| Manurial value obtainable, | 7.00 " | Total cost, | 13.89 cts. |
| Net cost, | 7.90 " | Manurial value obtainable, | 7.10 " |
| | | Net cost, | 6.79 " |

| III. | | IV. | |
|---|---|---|---|
| *December 1 to January 9.* | | *January 16 to February 28.* | |
| Wheat bran, | 3 lbs. | Wheat bran, | 4 lbs. |
| Buffalo gluten feed, | 3 " | Buffalo gluten feed, | 4 " |
| Corn stover, | 13 " | Corn and soja-bean ensilage, | 43 " |
| Nutritive ratio, | 1:8.00 | Nutritive ratio, | 1:5.80 |
| Total cost, | 9.40 cts. | Total cost, | 13.57 cts. |
| Manurial value obtainable, | 5.55 " | Manurial value obtainable, | 7.60 " |
| Net cost, | 3.85 " | Net cost, | 5.97 " |

## *Summary of Cost of the Above-stated Average Daily Fodder Rations.*

[Cents.]

| | Feeding Periods. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Total cost, | 14.90 | 13.89 | 9.40 | 13.57 |
| Manurial value obtainable,* | 7.00 | 7.10 | 5.55 | 7.60 |
| Net cost, | 7.90 | 6.79 | 3.85 | 5.97 |

---

* Allowing ninety-two per cent. of the fertilizing ingredients of the feed to be recovered in the manure.

*Gain required per Day in Pounds of Live Weight to cover Cost of Feed.*

| | Feeding Periods. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Total cost, | 3.50 | 3.27 | 2.21 | 3.19 |
| Net cost, | 1.86 | 1.60 | 0.91 | 1.40 |

*Live Weight actually produced per Day.*

| | | | | |
|---|---|---|---|---|
| | –* | –* | 0.98 | 1.84 |

*Cost of Feed per Pound of Live Weight gained.*

[Cents.]

| | | | | |
|---|---|---|---|---|
| Total cost, | – | – | 9.60 | 7.37 |
| Net cost, | – | – | 3.93 | 3.25 |

* Period too short to draw any conclusions.

### *Remarks on the Above Figures.*

It again appears that the gain in live weight about covers the net cost of the food consumed.

The comparison between corn stover and corn and soja-bean ensilage is not strictly fair, for in case of ration IV. two pounds extra of grain were fed.

Notice that, while the growth was much slower when the animals were fed corn stover, yet, because of its comparative cheapness and manurial value, the net cost of beef produced was fairly low.

Ration IV., consisting of grains and corn and soja-bean ensilage, also gave very favorable results, producing beef at a net cost of 3.25 cents per pound.

*Steer No. 1.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). | Dry Matter required to produce One Pound of Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Buffalo Gluten Feed. | Fodder Corn. | Serradella. | Corn Stover. | Corn and Soja-bean Ensilage. | | | | | | |
| **1892-93.** | | | | | | | | | | | | |
| Sept. 5 to Sept. 12, . . . | 3.00 | 3.00 | 70.00 | – | – | – | 27.47 | 1:8.7 | – | – | – | – |
| Sept. 17 to Sept. 28, . . . | 3.00 | 3.00 | 40.00 | 20.00 | – | – | 21.67 | 1:6.6 | – | – | – | – |
| Dec. 1 to Jan. 9, . . . | 3.00 | 3.00 | – | – | 11.45 | – | 15.28 | 1:8.0 | 1,111 | 1,137.5 | 0.66 | 26.5 |
| Jan. 24 to Feb. 28, . . . | 4.00 | 4.00 | – | – | – | 43.00 | 16.85 | 1:5.8 | 1,180 | 1,255.0 | 2.14 | 7.5 |

| | Pounds. |
|---|---|
| Live weight of animal at the beginning of the experiment, . . . . . . . . . | 1,111.00 |
| Live weight of animal at the close of the experiment, . . . . . . . . . | 1,255.00 |
| Live weight gained during the experiment, . . . . . . . . . . . . | 144.00 |
| Average gain in weight per day, . . . . . . . . . . . . . . | 1.60 |

*Steer No. 2.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). | Dry Matter required to produce One Pound of Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Buffalo Gluten Feed. | Fodder Corn. | Serradella. | Corn Stover. | Corn and Soja-bean Ensilage. | | | | | | |
| **1892-93.** | | | | | | | | | | | | |
| Sept. 5 to Sept. 12, | 3.00 | 3.00 | 70.00 | – | – | – | 27.47 | 1:8.7 | – | – | – | – |
| Sept. 17 to Sept. 28, | 3.00 | 3.00 | 40.00 | 20.00 | – | – | 21.67 | 1:6.6 | – | – | – | – |
| Dec. 1 to Jan. 9, | 3.00 | 3.00 | – | – | 9.64 | – | 13.66 | 1:7.5 | 1,055 | 1,117.5 | 1.31 | 10.43 |
| Jan. 24 to Feb. 28, | 3.88 | 3.88 | – | – | – | 41.00 | 16.41 | 1:5.8 | 1,150 | 1,215.0 | 1.55 | 10.60 |

| | Pounds. |
|---|---|
| Live weight of animal at the beginning of the experiment, | 1,055.00 |
| Live weight of animal at the close of the experiment, | 1,215.00 |
| Live weight gained during the experiment, | 160.00 |
| Average gain in weight per day, | 1.78 |

### *Conclusions.*

In answer to question 1: *What rations are best to produce the greatest growth for the least outlay of money?*

The experiment indicates: —

*a.* That those coarse fodders should be grown and fed that produce the largest amount of dry matter upon a given area; leguminous crops are especially valuable as coarse fodders.

*b.* Such coarse foods as corn fodder, corn ensilage, corn and soja-bean ensilage, and vetch and oats take the place of hay, and when fed in combination with concentrated nitrogenous feed stuffs, as in rations given, have produced very favorable results.

*c.* Animals are more than machines, — they are living beings, of so complicated a nature that they are very liable to get out of order, or, not being in the proper condition, they fail to respond to the foods fed as expected. Therefore, one experiment is not in itself sufficient to enable any one to judge with certainty as to the comparative merits of different foods, but it serves rather as a link in the chain of evidence. When the experiments in this line are completed, the combined evidence will be instrumental in pointing out lessons of permanent value.

## II. THE COST OF BEEF PRODUCTION.

For a considerable time the idea has been prevalent among intelligent farmers in Massachusetts that beef production could not be carried on with profit. No extended observations have been made, however, or no accurate accounts kept that would give any facts to show at what price beef could actually be produced; and in order to answer this question, experiments have been carried on at the station for several years. The following record is presented as a result of the experiment with the two steers already described. The steers were purchased Nov. 19, 1891, at 3½ cents per pound of live weight, and sold Feb. 28, 1893, at 4¼ cents per pound of live weight. They were not put out to pasture during the summer of 1892, but were kept in the barn or turned into the yard, and were fed a variety of green crops with grains.

### *Steer No. 1.*

| FODDER ARTICLES. | Feed consumed (Pounds). | Dry Matter (Pounds). | Local Market Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|---|
| Wheat bran, . . . | 1,403 | 1,262.7 | $14 73 | $7 71 | $7 02 |
| Chicago maize feed, . | 389 | 355.0 | 4 86 | 2 21 | 2 65 |
| Buffalo gluten feed, . | 964 | 892.0 | 10 60 | 5 54 | 5 06 |
| Cotton-seed meal, . . | 56 | 51.0 | 0 78 | 0 55 | 0 23 |
| Hay, . . . . | 821 | 741.0 | 6 15 | 2 24 | 3 91 |
| Corn fodder, . . . | 2,637 | 831.0 | 3 29 | 1 35 | 1 94 |
| Corn stover, . . . | 1,538 | 1,291.9 | 3 84 | 3 22 | 0 62 |
| Dent corn ensilage, . | 1,178 | 235.6 | 1 47 | 0 68 | 0 79 |
| Sweet corn ensilage, . | 1,214 | 190.5 | 1 51 | 0 59 | 0 92 |
| Corn and soja-bean ensilage, . . . . | 2,130 | 472.8 | 2 92 | 1 49 | 1 43 |
| Green rye, . . . | 474 | 179.6 | 0 59 | 0 39 | 0 20 |
| Peas and oats (green), . | 470 | 64.4 | 0 64 | 0 34 | 0 30 |
| Vetch and oats (green), . | 1,160 | 208.8 | 1 59 | 1 04 | 0 55 |
| Serradella (green), . | 523 | 95.0 | 0 72 | 0 42 | 0 30 |
| Cabbages, . . . | 636 | 60.4 | 0 79 | 0 39 | 0 40 |
| Turnips, . . . . | 460 | 45.2 | 0 57 | 0 21 | 0 36 |
| Mangolds, . . . | 306 | 37.3 | 0 61 | 0 15 | 0 46 |
| Sugar beets, . . . | 366 | 53.8 | 0 91 | 0 22 | 0 69 |
| Other green crops, . . | 427 | 59.9 | 0 53 | 0 26 | 0 27 |
| | | 7,127.9 | $57 10 | $29 00 | $28 10 |

| | Pounds. |
|---|---|
| Live weight of animal when purchased, . . . . | 588 |
| Live weight of animal when sold, . . . . . . | 1,255 |
| Total gain during the experiment, . . . . . . | 667 |

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of steer, 588 pounds at 3½ cents, | $20 47 | |
| Total cost of feed, | 57 10 | |
| Selling price of steer, 1,255 pounds at 4¼ cents, | | $53 34 |
| Value of manure produced, | | 29 00 |
| | $77 57 | $82 34 |

| | |
|---|---|
| Total cost of feed required to produce 1 pound of live weight, | 8.55 cts. |
| Net cost of feed required to produce 1 pound of live weight, | 4.22 " |
| Average gain in weight per day, | 1.43 lbs. |
| Dry matter required to produce 1 pound of live weight, | 10.64 " |

*Steer No. 2.*

| Fodder Articles. | Feed consumed (Pounds). | Dry Matter (Pounds). | Local Market Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|---|
| Wheat bran, | 1,350 | 1,214.5 | $14 17 | $7 42 | $6 75 |
| Chicago maize feed, | 389 | 354.0 | 4 86 | 2 21 | 2 65 |
| Buffalo gluten feed, | 911 | 841.5 | 10 01 | 5 23 | 4 78 |
| Cotton-seed meal, | 56 | 51.0 | 0 78 | 0 55 | 0 23 |
| Hay, | 767 | 692.6 | 5 75 | 2 11 | 3 64 |
| Corn fodder, | 2,638 | 831.0 | 3 29 | 1 35 | 1 94 |
| Corn stover, | 1,342 | 1,127.3 | 3 35 | 2 81 | 0 54 |
| Dent corn ensilage, | 1,169 | 233.8 | 1 46 | 0 68 | 0 78 |
| Sweet corn ensilage, | 1,400 | 220.0 | 1 75 | 0 67 | 1 08 |
| Corn and soja-bean ensilage, | 2,041 | 453.1 | 2 80 | 1 43 | 1 37 |
| Green rye, | 474 | 179.6 | 0 59 | 0 39 | 0 20 |
| Peas and oats (green), | 470 | 64.4 | 0 69 | 0 34 | 0 35 |
| Vetch and oats (green) | 1,160 | 208.8 | 1 59 | 1 04 | 0 55 |
| Serradella (green), | 483 | 86.9 | 0 66 | 0 39 | 0 27 |
| Cabbages, | 635 | 60.4 | 0 79 | 0 39 | 0 40 |
| Turnips, | 460 | 45.2 | 0 57 | 0 21 | 0 36 |
| Mangolds, | 306 | 37.3 | 0 61 | 0 15 | 0 46 |
| Sugar beets, | 366 | 53.8 | 0 91 | 0 22 | 0 69 |
| Other green crops, | 427 | 59.9 | 0 53 | 0 27 | 0 26 |
| | | 6,815.1 | $55 16 | $27 86 | $27 30 |

| | Pounds. |
|---|---|
| Live weight of animal when purchased, | 595 |
| Live weight of animal when sold, | 1,215 |
| Total gain during experiment, | 620 |

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of steer, 595 pounds, at 3½ cents, . . | $20 82 | |
| Total cost of feed, . . . . . . . . | 55 16 | |
| Selling price of steer, 1,215 pounds, at 4¼ cents, . | | $51 64 |
| Value of manure produced, . . . . . . | | 27 57 |
| | $75 98 | $79 21 |

| | |
|---|---|
| Total cost of feed required to produce 1 pound of live weight, | 8.90 cts. |
| Net cost of feed required to produce 1 pound of live weight, | 4.40 " |
| Average gain in weight per day, . . . . . . . | 1.32 lbs. |
| Dry matter required to produce 1 pound of live weight, . | 10.99 " |

## *Conclusions.*

In answer to inquiry II. : — *The cost of beef production.*

*a.* The financial statement shows that, excluding the cost of labor, the coarse fodder articles and grains have been sold at market rates, and have been a trifle more than paid for in the value of the beef and of the manure produced. The value of the latter is calculated on the basis of the current market rates for nitrogen, phosphoric acid and potash.

*b.* Taking an average of the two steers, the total cost of producing 1 pound of live weight was 8.7 cents and the net cost 4¼ cents.

*c.* The average daily gain for the entire experiment (467 days) was 1.37 pounds, and the dry matter required to produce 1 pound of gain was 10.82 pounds.

*d.* These results are interesting, if not encouraging. The experiments are being continued, and it is hoped that in the next report the results of the work in this direction for the past four years can be presented. The results of one experiment are by no means conclusive. It is only when the average of a considerable number of experiments, in which all or nearly all give practically the same results, that the desired facts are obtained.

## III. SUMMER SOILING *vs.* PASTURE.

The third object of the present steer-feeding experiment was to ascertain the relative merits of summer soiling *vs.*

pasture for growing steers. With this end in view the steers were kept in the barn during the summer or turned into the barn-yard and fed with a variety of green crops raised upon the station grounds in connection with grain. Steers 1 and 2 consumed practically the same amount of feed during this period.

*Feed consumed by each Steer during Summer Soiling.*

| Fodder Articles. | Feed consumed (Pounds). | Local Market Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| Wheat bran, | 454 | $4 59 | $2 49 | $2 10 |
| Buffalo gluten feed, | 454 | 5 04 | 2 87 | 2 17 |
| Hay, | 232 | 1 74 | 0 63 | 1 11 |
| Corn fodder, | 2,372 | 2 96 | 1 22 | 1 74 |
| Green rye, | 474 | 0 59 | 0 39 | 0 20 |
| Peas and oats (green), | 470 | 0 69 | 0 33 | 0 36 |
| Vetch and oats (green), | 1,160 | 1 59 | 1 04 | 0 55 |
| Serradella (green), | 383 | 0 52 | 0 31 | 0 21 |
| Cabbages, | 496 | 0 62 | 0 31 | 0 31 |
| Sugar beets, | 240 | 0 60 | 0 16 | 0 44 |
| Other green crops, | 387 | 0 53 | 0 26 | 0 27 |
| | | $19 47 | $10 01 | $9 46 |

*Summer Soiling compared with Pasture.*

| | Soiling. | | Pasture. | |
|---|---|---|---|---|
| | Steer 1. | Steer 2. | Average Two Steers. 1890. | Average Three Steers. 1891. |
| Date of beginning experiment, | May 1. | May 1. | May 10. | April 27. |
| Date of ending experiment, | Sept. 30. | Sept. 30. | Sept. 30. | Nov. 3. |
| Number of days, | 153 | 153 | 144 | 190 |
| Live weight of steers at beginning of experiment, | 818 | 827 | 867 | 828 |
| Live weight of steers at end of experiment, | 1,040 | 1,015 | 971 | 935 |
| Total weight gained, | 232 | 188 | 104 | 107 |
| Average gain in weight per day, | 1.52 | 1.23 | 0.72 | 0.57 |
| Total cost of feed per day, soiling (cents), | 12.72 | 12.72 | - | - |
| Net cost of feed per day, soiling (cents), | 6.18 | 6.18 | - | - |
| Total cost of feed per day at 40 cents per week for pasture (cents), | - | - | 5.71 | 3.57* |
| Total cost of feed required to produce one pound of live weight (cents), | 8.39 | 10.35 | 8.24 | 6.36 |
| Net cost of feed required to produce one pound of live weight (cents), | 4.08 | 5.03 | - | - |

* Allowing 25 cents per week for pasture.

### *Comments on the results of inquiry III.*

The above experiment with soiling in case of growing steers is the first tried at the station. Another experiment with three steers is under way, and will be reported later.

It will be seen from the table that: —

1. The different steers gained from two to three times as much in live weight per day when fed at home as when pastured.

2. The price paid for the pasture will in a measure govern the profit and loss of the operation.

3. The total cost of the feed required to produce one pound of live weight was approximately the same in the different experiments. In case of the three steers pastured in 1891, the cost of feed per day, 6.36 cents, was less than in the case of the soiling experiment, being due to the low price paid for the pasture.

4. In case of soiling, the net cost of feed required to produce one pound of live weight, 4 to 5 cents, proved to be about one-half the total cost. In other words, the chief gain seems to have been in the value of the manure produced.

### *Disadvantages of Pasture.*

1. The uncertainty of the supply of food, being governed (*a*) by the weather and (*b*) by the general poor condition of the New England grazing lands.

2. The loss of the manure.

3. The loss of live weight, apparently unavoidably connected with a system of changing from stall feeding to pasturing and back again. This loss has generally amounted to from 20 to 30 pounds of live weight per animal.

4. The slowness of the gain in live weight as compared with soiling.

### *Advantages and Disadvantages of Soiling.*

1. The experiment shows that nearly three times as much gain in live weight per day has been produced by soiling as by pasturing.

2. The chief disadvantage would be in the cost of the labor required to care for the animals during this period, and the expense in growing the green crops.

3. An advantage would be found in the greatly increased amount of fodder produced on the land in a state of cultivation.

It appears from the facts thus far shown that no absolute rule can be laid down to govern all cases. The subject, however, is worthy of the serious attention of the farmers, though local conditions and circumstances will greatly affect the decision as to which system is the more suitable for the particular locality.

# III.

## WINTER FEEDING EXPERIMENT WITH LAMBS.

---

*November, 1892, to March, 1893.*

The experiment about to be described is the fourth in a series designed to ascertain how best to feed the various grains and coarse fodders in order to produce the greatest live weight at the lowest possible cost.

### Objects of the Experiment.

The objects of this experiment were threefold: —

I. To ascertain the economy of feeding a greater *vs.* a less quantity of protein in the daily fodder rations, *i. e.*, the old question of wide *vs.* narrow rations.

II. To see if mutton could not be produced cheaper by feeding ensilage as a part substitute for rowen, *i. e.*, to get cheaper fodder rations that would prove equally effective.

III. To ascertain what it actually costs to produce a pound of live or dressed weight.

### 1. General Description.

Six grade Southdown wethers were purchased Nov. 9, 1892, of Mr. G. L. Henry. Each sheep was kept in a separate pen during the entire experiment.

The average weight was about 60 pounds, and they cost 6 cents per pound. The market price at this time was 5½ cents, but, as these animals had been on the road for several days without much food, the seller considered 6 cents a fair price. The sheep were kept in the stable for ten days, to get them accustomed to their surroundings, and were fed during that time upon Buffalo gluten feed and soja-bean straw. They were sheared November 18, with the following results: —

| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. | No. 6. |
|---|---|---|---|---|---|---|
| Weight before shearing, . . . | 60.50 | 65.00 | 66.00 | 74.25 | 69.00 | 67.75 |
| Weight after shearing, . . . . | 56.75 | 60.75 | 62.50 | 70.25 | 65.25 | 64.50 |
| Weight of wool, . . . . . | 3.75 | 4.25 | 3.50 | 4.00 | 3.75 | 3.25 |

### 2. Fodder Articles Fed.

The grain feed consisted of Buffalo gluten feed and cotton-seed meal of good average quality and condition.

The coarse fodder consisted of a fairly good quality of rowen and an average quality of corn and soja-bean ensilage, raised and prepared upon the station grounds.

### 3. Local Market Cost, per Ton, of the Various Articles of Fodder used.

| | |
|---|---|
| Buffalo gluten feed, . . . . . . . | $21 00 |
| Cotton-seed meal, . . . . . . . | 28 00 |
| Rowen, . . . . . . . . . | 15 00 |
| Corn and soja-bean ensilage, . . . . . | 2 75 |

### 4. Mode of Feeding.

The animals were fed twice each day, about eight o'clock in the morning and at five in the afternoon, one-half the feed being given at each time. Water was offered *ad libitum*. About five grammes ($\frac{1}{6}$ ounce) of salt were fed daily, mixed with the grain.

## I. TO ASCERTAIN THE ECONOMY OF FEEDING A GREATER *vs.* A LESS QUANTITY OF PROTEIN IN THE DAILY FODDER RATIONS.

The animals were divided into two lots of three each, each sheep, as before stated, being kept in a separate pen.

Lot I., consisting of sheep No. 1, No. 2 and No. 3, was fed a ration having a nutritive ratio of 1 : 4.5 during the entire experiment, which began Nov. 19, 1892, and closed March 13, 1893.

Lot II., consisting of sheep No. 4, No. 5 and No. 6, was fed a ration of 1 : 5.5 from Nov. 19, 1892, till Feb. 15, 1893, when the ratio was changed to 1 : 4.5, and so continued till March 13, 1893.

Both lots received approximately the same amount of digestible organic matter.

*Analyses of the Various Articles of Fodder used.*

| FODDER ANALYSES. | Buffalo Gluten Feed. | Cotton-seed Meal | Rowen. | Corn and Soja-bean Ensilage. |
|---|---|---|---|---|
| Moisture at 100° C., | 7.18 | 6.20 | 11.30 | 77.77 |
| Dry matter, | 92.82 | 93.80 | 88.70 | 22.23 |
| | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | |
| Crude ash, | 0.84 | 7.37 | 6.48 | 9.48 |
| " cellulose, | 7.50 | 5.81 | 29.98 | 26.63 |
| " fat, | 12.75 | 13.04 | 4.23 | 3.75 |
| " protein, | 26.28 | 44.71 | 12.11 | 7.91 |
| Non-nitrogenous extract matter, | 52.63 | 28.57 | 47.20 | 52.23 |
| | 100.00 | 100.00 | 100 00 | 100.00 |

*Fertilizing Constituents.*

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

| FERTILIZER ANALYSES. | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. |
|---|---|---|---|---|
| Moisture, | 7.18 | 6.20 | 11.30 | 77.77 |
| Nitrogen, | 4.25 | 7.15 | 1.94 | 0.32 |
| Phosphoric acid, | 0.30 | 2.33 | 0.46 | 0.12 |
| Potassium oxide, | 0.04 | 1.72 | 1.97 | 0.48 |
| Valuation per 2,000 pounds, | $13 13 | $25 56 | $8 10 | $1 52 |
| Manurial value obtainable, | 12 07 | 23 57 | 7 45 | 1 40 |

*Average Composition of the Daily Fodder Rations used during the Successive Feeding Periods.*

*Lot I.*

| I. | | II. | |
|---|---|---|---|
| *November 19 to November 30.* | | *December 1 to January 9.* | |
| Buffalo gluten feed, | 0.62 lbs. | Buffalo gluten feed, | 0.87 lbs. |
| Cotton-seed meal, | 0.12 “ | Cotton-seed meal, | 0 20 “ |
| Rowen, | 1.25 “ | Rowen, | 1.75 “ |
| Nutritive ratio, | 1:4.5 | Nutritive ratio, | 1:4 6 |
| Total cost, | 1.76 cts. | Total cost, | 2.50 cts. |
| Manurial value obtainable, | 0.97 “ | Manurial value obtainable, | 1.39 “ |
| Net cost, | 0.79 “ | Net cost, | 1.11 “ |

| III. | |
|---|---|
| *January 24 to March 17* | |
| Buffalo gluten feed, | 0.87 lbs. |
| Cotton-seed meal, | 0.20 “ |
| Rowen, | 0.50 “ |
| Corn and soja-bean ensilage, | 3.00 “ |
| Nutritive ratio, | 1:4.7 |
| Total cost, | 1.97 cts. |
| Manurial value obtainable, | 1.15 “ |
| Net cost, | 0.82 “ |

*Lot II.*

| I. | | II. | |
|---|---|---|---|
| *November 19 to November 30.* | | *December 1 to January 9.* | |
| Buffalo gluten feed, | 0.50 lbs. | Buffalo gluten feed, | 0.62 lbs. |
| Rowen, | 1.75 “ | Rowen, | 2.00 “ |
| Nutritive ratio, | 1:5.5 | Nutritive ratio, | 1:5.5 |
| Total cost, | 1.81 cts. | Total cost, | 2.15 cts. |
| Manurial value obtainable, | 0.95 “ | Manurial value obtainable, | 1.11 “ |
| Net cost, | 0.86 “ | Net cost, | 1.04 “ |

| III. | | IV. | |
|---|---|---|---|
| *January 24 to February 15.* | | *February 20 to March 7.* | |
| Buffalo gluten feed, | 0.62 lbs. | Buffalo gluten feed, | 0 90 lbs. |
| Cotton-seed meal, | 0.12 “ | Cotton-seed meal, | 0.20 “ |
| Rowen, | 0.50 “ | Rowen, | 0.50 “ |
| Corn and soja-bean ensilage, | 4.50 “ | Corn and soja-bean ensilage, | 3.00 “ |
| Nutritive ratio, | 1:5.7 | Nutritive ratio, | 1:4.7 |
| Total cost, | 1.78 cts. | Total cost, | 1.97 cts. |
| Manurial value obtainable, | 1.01 “ | Manurial value obtainable, | 1.15 “ |
| Net cost, | 0.77 “ | Net cost, | 0.82 “ |

### *Digestible Matter in the Above Rations.*

[Ounces.]

| | Feeding Periods. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Lot I. | | | Lot II. | | | |
| | I. | II. | III. | I. | II. | III. | IV. |
| Protein, . . | – | 5.40 | 4.66 | – | 4.16 | 3.82 | 4.66 |
| Fat, . . . | – | 2.05 | 2.18 | – | 1.48 | 1.86 | 2.18 |
| Carbo-hydrates, | – | 19.91 | 16.49 | – | 19.08 | 17.00 | 16.49 |
| Total, . . | – | 27.36 | 23.33 | – | 24.72 | 22.68 | 23.33 |

It will be noticed that Lot I. was fed with one exception more protein than Lot II., thus giving the narrow ration. The total amount of digestible organic matter, however, remained essentially the same during each parallel period. During the second feeding period both lots consumed more feed daily than at any other time.

### *Summary of Cost of the Above-stated Average Daily Fodder Rations.*

[Cents.]

| | Feeding Periods. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Lot I. | | | Lot II. | | | |
| | I. | II. | III. | I. | II. | III. | IV. |
| Total cost, . . | 1.76 | 2.50 | 1.97 | 1.81 | 2.15 | 1.78 | 1.97 |
| Manurial value obtainable,* . | 0.97 | 1.39 | 1.10 | 0.95 | 1.11 | 1.01 | 1.15 |
| Net cost, . . | 0.79 | 1.11 | 0.87 | 0.86 | 1.04 | 0.77 | 0.82 |

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* Allowing ninety-two per cent. of the fertilizing ingredients of the feed to be recovered in the manure.

*Comparisons of Lot I. (Ratio 1:4.5) with Lot II. (Ratio 1:5.5).*

| | Lot I. | Lot II. |
|---|---|---|
| | Weight. | Weight. |
| Beginning of experiment, November 19, | 180.0 lbs. | 200.0 lbs. |
| Close of experiment, February 14, | 252.5 " | 267.0 " |
| Gain during experiment, | 72.5 " | 67.0* " |

The next step would be to inquire into the cost of feed consumed by Lots I. and II., thus ascertaining the cost per pound of live weight gained.

| | Lot I. | | | | Lot II. | | | |
|---|---|---|---|---|---|---|---|---|
| | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. |
| **Feed consumed (pounds),** | 214.40 | 44.00 | 303.25 | 236.00 | 165.30 | 9.37 | 345.25 | 364.75 |
| **Total cost,** | $2 25 | $0 62 | $2 27 | $0 32 | $1 74 | $0 13 | $2 59 | $0 50 |
| **Manurial value obtainable,** | 1 29 | 0 52 | 1 12 | 0 17 | 0 99 | 0 11 | 1 28 | 0 26 |
| **Net cost,** | 0 96 | 0 10 | 1 15 | 0 15 | 0 75 | 0 02 | 1 31 | 0 24 |

| | Lot I. | Lot II. |
|---|---|---|
| Live weight gained during experiment, | 72.5 lbs. | 67.0 lbs. |
| Total cost of feed, | $5 46 | $4 96 |
| Net cost of feed, | 2 36 | 2 32 |
| Total cost of feed per pound of live weight gained, | 7.53 cts. | 7.42 cts. |
| Net cost of feed per pound of live weight gained, | 3.25 " | 3.48 " |

---

* Sheep No. 6, in Lot II., suffered from a severe cold during practically the entire month of December, and, consequently, did not eat as well nor gain as rapidly as the other two in this lot. Had No. 6 made the same average growth as sheep No. 4 and No. 5, the gain in live weight in Lots I. and II. would have been practically identical.

### SUMMARY.

Lot I., narrow ration, 1 : 4.5.

Lot II., wider ration, 1 : 5.5.

Length of experiment, 88 days.

*In answer to question I.* viz., the economy of feeding rations with a nutritive ratio of 1 : 5.5 *vs.* one with a nutritive ratio of 1 : 4.5, the experiment gives the following: —

1. The gain in live weight is somewhat in favor of Lot I., to which more protein was fed.

2. The total cost of producing one pound of live weight with Lot I. was 7.53 cents and with Lot II. 7.42 cents, while the net cost with Lot I. was 3.25 cents, a little lower than with Lot II., which was 3.48 cents.

3. The results of the experiment are practically identical in case of both lots. Had sheep No. 6 been in good health during December, and made the same relative gain as No. 4 and No. 5, the results would have been rather in favor of Lot II.

4. Sheep Nos. 4 and 5 were not slaughtered. Sheep No. 3 was the fattest, No. 6 next, then came No. 1 and lastly No. 2. These results give no positive information, but would indicate in this case that the constitutional tendency of the animal, rather than the feed consumed, governed the amount of fat and flesh produced.

### THE SITUATION BRIEFLY STATED.

This experiment would indicate, and it is borne out by the majority of other experiments made with reference to this point, that for the production of lean and fat in case of growing animals a ratio of 1 : 5 to 1 : 5.5 is about as economical a one as can be fed.

In order to get more definite light upon this matter, one must await the results of the carefully conducted experiments with the so-called respiration apparatus now in progress, or a large number of animals must be experimented with, and the average results taken.

It is certainly true that the constitution of the animal, no less than the quantity and proportion in which the different food components are fed, exerts a decided influence upon the production of both lean meat and fat. Experiments, therefore, after the manner of the one previously described, must be conducted with a large number of sheep, in order to eliminate as far as possible this source of error, and furnish data that will throw more definite light upon the subject. It is held by many who have good grounds upon which to base their belief that rations with a ratio of 1 : 4 can be economically fed.

## OBJECT II. TO SEE IF LIVE WEIGHT COULD NOT BE PRODUCED CHEAPER BY SUBSTITUTING CORN AND SOJA-BEAN ENSILAGE TO A CONSIDERABLE EXTENT FOR ROWEN.

Feeding Period I. The six sheep used in the experiment were fed for seven weeks upon Buffalo gluten feed, cotton-seed meal and rowen.

Feeding Period II. In this period corn and soja-bean ensilage was substituted for the larger part of the rowen.

The following table gives the amounts of the several foods consumed and the total and net cost of the same, as well as the total and net cost of feed required to produce one pound of live weight.

| | FEEDING PERIOD I. | | | | FEEDING PERIOD II. | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Dry Matter. | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. | Dry Matter. |
| Feed consumed (pounds), | 204.25 | 24.75 | 497.50 | 653.74 | 245.25 | 54.56 | 150.00 | 826.50 | 595.00 |
| Total cost, . . . . | $2 14 | $0 35 | $3 75 | - | $2 57 | $0 76 | $1 12 | $1 13 | - |
| Manurial value obtainable, | 1 22 | 0 29 | 1 84 | - | 1 47 | 0 64 | 0 55 | 0 58 | - |
| Net cost, . . . . | 0 92 | 0 06 | 1 91 | - | 1 10 | 0 12 | 0 57 | 0 55 | - |

| | Feeding Period I. | Feeding Period II. |
|---|---|---|
| Weight at the beginning of the experiment, . | 380.00 lbs. | 485.75 lbs. |
| Weight at the end of the experiment, . . | 461.50 " | 565.00 " |
| Gain in weight during experiment, . . | 81.50 " | 79.25 " |
| Total cost of feed, . . . . . . . . | $6 26 | $5 58 |
| Net cost of feed, . . . . . . . . | 2 89 | 2 34 |
| Total cost of feed per pound of live weight gained, . . . . . . . . | 7.68 cts. | 7.04 cts. |
| Net cost of feed per pound of live weight gained, . . . . . . . . | 3.55 " | 2.95 " |
| Dry matter required to produce 1 pound of live weight, . . . . . . . . | 8.00 " | 7.51 " |

### ANSWER TO OBJECT II.

The result of the experiment is in favor of the corn and soja-bean ensilage as a substitute for a larger part of the rowen.

The total and net cost of feed required to produce one pound of live weight in Feeding Period I. was 7.68 cents and 3.55 cents, while in Feeding Period II. it was but 7.04 cents and 2.95 cents.

The dry matter required to produce one pound of live weight was also somewhat less in Feeding Period II. This answer coincides with many other experiments made at this station, and shows that in order to produce beef or mutton at the lowest cost cheap fodders must be fed in place of costly hay. Well-made corn ensilage proves a very excellent and economical substitute.

### OBJECT III. TO ASCERTAIN, IN THE CASE OF GROWING LAMBS, WHAT IT COSTS TO PRODUCE ONE POUND OF LIVE OR DRESSED WEIGHT.

While this question has been in a measure answered under II., still, it is well to make a complete financial statement of the experiment. The feeding experiment proper began on Nov. 19, 1892. The sheep were sheared on the day previous. They were fed till March 13, 1893, upon which date they were again sheared, and sold at 11 cents per pound of dressed weight.

*Live Weight gained during the Experiment (115 Days).*

[Pounds.]

| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. | No. 6. |
|---|---|---|---|---|---|---|
| Beginning of experiment, . | 56.75 | 60.75 | 62.50 | 70.25 | 65.25 | 64.50 |
| End of experiment, . . | 95.50 | 87.75 | 93.50 | 102.00 | 96.50 | 89.75 |
| Gain during experiment, . | 38.75 | 27.00 | 31.00 | 31.75 | 31.25 | 25.25 |

### *Yield of Wool and Dressed Weight.*

[Pounds.]

| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. | No. 6. |
|---|---|---|---|---|---|---|
| Yield of wool at beginning of experiment, . . . | 3.75 | 4.25 | 3.50 | 4.00 | 3.75 | 3.25 |
| Yield of wool during experiment (115 days), . . | 3.00 | 3.00 | 2.13 | –* | –* | 2.75 |
| Yield of dressed weight, . | 48.50 | 43.75 | 48.25 | – | – | 45.25 |

* Retained for further experiments.

### *Feed consumed.*

| | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|
| 525.0 pounds Buffalo gluten feed, . . | $5 51 | $3 15 | $2 36 |
| 87.3 pounds cotton-seed meal, . . | 1 22 | 1 02 | 0 20 |
| 730.0 pounds rowen, . . . . . | 5 47 | 2 70 | 2 77 |
| 1,449.0 pounds corn and soja-bean ensilage, | 1 99 | 1 01 | 0 98 |
| | $14 19 | $7 88 | $6 31 |

### *Average Results.*

| | |
|---|---|
| Total weight at the beginning of the experiment (sheared), | 380.00 lbs. |
| Total weight at the end of the experiment, . . . . | 565.00 " |
| Total gain in live weight, . . . . . . . . | 185.00 " |
| Average gain per sheep in live weight per day (115 days), . | 0.27 " |
| Average shrinkage (four sheep) in dressing, . . . | 49.32 " |
| Total cost of feed per pound of live weight gained, . . | 7.67 cts. |
| Total cost of feed per pound of dressed weight gained, . | 15.13 " |
| Net cost of feed per pound of live weight gained, . . | 3.41 " |
| Net cost of feed per pound of dressed weight gained, . . | 6.70 " |

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| 402.50 pounds live weight, at 5½ cents, . . | $22 14 | – |
| Cost of feed, . . . . . . . | 14 19 | – |
| 283.60 * pounds dressed weight, at 11 cents, . | – | $31 20 |
| 39.38 pounds of wool, at 21 cents, . . . | – | 8 27 |
| Value of manure produced, . . . . | – | 7 68 |
| | $36 33 | $47 15 |
| Balance in favor of credit, . . . . | $10 82 | – |

---

* Assuming that Nos. 4 and 5 would shrink the same amount in dressing as Nos. 1, 2, 3 and 6.

## ANSWER TO OBJECT III.

The results show (*a*) that the average total cost of feed required to produce one pound of live weight, on the retail price of coarse fodders and grains, as previously stated, was 7.67 cents, and the net cost 3.41 cents; the total cost per pound of dressed weight was 15.13 cents and the net cost 6.94 cents.

(*b*) The profit and loss account shows that the financial advantages of feeding yearlings during the winter are to be found, first, in selling the coarse fodder articles at a fair retail price; and, second, in the value of the manure produced. It also makes this fact very emphatic, viz., that the manure, solid as well as liquid, should be carefully guarded from any loss. The manure is valuable chiefly for the nitrogen, phosphoric acid and potash it contains, as these ingredients cost respectively 15 cents, 5½ cents and 4½ cents per pound in the markets. The manure, reckoned on this basis, has been found to be equal to one-half the cost of the feed consumed.

## DETAILED RECORD OF EACH SHEEP.

### *Sheep No. 1.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Gain in Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound Live Weight. | Total Gain in Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| | Buffalo Gluten Feed. | Cotton - seed Meal. | Rowen. | Corn and Soja - bean Ensilage. | | | | | |
| **1892-93.** | | | | | | | | | |
| Nov. 19 to Jan. 10, . | 0.79 | 0.16 | 1.53 | - | 2.24 | 1:4.5 | 0.375 | 5.97 | 19.50 |
| Jan. 24 to March 14, | 0.87 | 0.20 | 0.50 | 2.81 | 2.06 | 1:4.6 | 0.224 | 9.22 | 10.95 |

### *Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.*

| | Dry Matter. | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 94.48 pounds Buffalo gluten feed, . | 87.68 | $0 99 | $0 56 | $0 43 |
| 20.02 pounds cotton-seed meal, . | 18.77 | 0 28 | 0 23 | 0 05 |
| 112.56 pounds rowen, . . . | 99.84 | 0 84 | 0 36 | 0 48 |
| 171.69 pounds corn and soja-bean ensilage, . . . . . . | 39.17 | 0 23 | 0 10 | 0 13 |
| | 245.46 | $2 34 | $1 25 | $1 09 |

| | | |
|---|---|---|
| Live weight of animal at the beginning of the experiment, | 56.75 | lbs. |
| Live weight of animal at the end of the experiment, . . | 92.50 | " |
| Live weight gained during the experiment, . . . | 35.75 | " |
| Average gain in weight per day, . . . . . . . | 0.31 | " |
| Dressed weight of animal, . . . . . . . | 48.50 | " |
| Loss in weight by dressing, 47.56 per cent., . . . | 44.00 | " |
| Pounds of dry matter fed produced 1 pound of live weight, | 6.86 * | " |
| Total cost of feed per pound of live weight gained, . . | 6.54 | cts. |
| Net cost of feed per pound of live weight gained, . . | 3.05 | " |

---

* Exclusive of wool.

### *Sheep No. 2.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Gain in Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound Live Weight. | Total Gain in Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. | | | | | |
| **1892-93.** | | | | | | | | | |
| Nov. 19 to Jan. 10, . | 0.78 | 0.16 | 1.57 | - | 2.26 | 1:4.5 | 0.279 | 8.10 | 14.50 |
| Jan. 24 to March 14, | 0.87 | 0.20 | 0.50 | 2.13 | 1.91 | 1:4.4 | 0.189 | 10.12 | 9.25 |

### *Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.*

| | Dry Matter. | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 93.44 pounds Buffalo gluten feed, | 86.73 | $0 99 | $0 56 | $0 43 |
| 20.06 pounds cotton-seed meal, . | 18.77 | 0 28 | 0 22 | 0 06 |
| 114.64 pounds rowen, . . . | 100.68 | 0 86 | 0 37 | 0 49 |
| 135.62 pounds corn and soja-bean ensilage, . . . . . | 30.15 | 0 19 | 0 08 | 0 11 |
| | 236.33 | $2 32 | $1 23 | $1 09 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 60.75 lbs. |
| Live weight of animal at the end of the experiment, . . | 84.75 " |
| Live weight gained during the experiment, . . . . . | 24.00 " |
| Average gain in weight per day, . . . . . . | 0.21 " |
| Dressed weight of animal, . . . . . . . . | 43.75 " |
| Loss in weight by dressing, 48.37 per cent., . . . . | 41.00 " |
| Pounds of dry matter fed produced 1 pound of live weight, . | 9.84 " |
| Total cost of feed per pound of live weight gained, . . | 9.66 cts. |
| Net cost of feed per pound of live weight gained, . . | 4.54 " |

### *Sheep No. 3.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Gain in Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound Live Weight. | Total Gain in Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. | | | | | |
| **1892-93.** | | | | | | | | | |
| Nov. 19 to Jan. 10, . | 0.81 | 0.16 | 1.51 | – | 2.25 | 1:4.5 | 0.317 | 7.09 | 16.50 |
| Jan. 24 to March 14, | 0.87 | 0.20 | 0.50 | 2.68 | 2.03 | 1:4.5 | 0.214 | 9.47 | 10.50 |

### *Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.*

| | Dry Matter. | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 95.00 pounds Buffalo gluten feed, . | 87.17 | $0 99 | $0 56 | $0 43 |
| 20.54 pounds cotton-seed meal, . | 19.26 | 0 29 | 0 24 | 0 05 |
| 111.52 pounds rowen, . . . | 98.92 | 0 83 | 0 36 | 0 47 |
| 164.22 pounds corn and soja-bean ensilage, . . . . . . | 36.50 | 0 22 | 0 10 | 0 12 |
| | 241.85 | $2 33 | $1 26 | $1 07 |

| | | |
|---|---|---|
| Live weight of animal at the beginning of the experiment, . | 62.50 | lbs. |
| Live weight of animal at the end of the experiment, . . | 91.50 | " |
| Live weight gained during the experiment, . . . . . | 29.00 | " |
| Average gain in weight per day, . . . . . . . | 0.25 | " |
| Dressed weight of animal, . . . . . . . . | 48.25 | " |
| Loss in weight by dressing, 47.26 per cent., . . . . . | 43.25 | " |
| Pounds of dry matter fed produced 1 pound of live weight, . | 8.54 | " |
| Total cost of feed per pound of live weight gained, . . | 8.03 | cts. |
| Net cost of feed per pound of live weight gained, . . . | 3.70 | " |

*Sheep No. 4.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Gain in Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound Live Weight. | Total Gain in Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. | | | | | |
| **1892-93.** | | | | | | | | | |
| Nov. 19 to Jan. 10, . | 0.60 | – | 1.88 | – | 2.22 | 1:5.5 | 0.298 | 7.45 | 15.50 |
| Jan. 24 to Feb. 15, . | 0.534 | 0.125 | 0.50 | 3.79 | 1.90 | 1:5.6 | 0.250 | 7.60 | 5.50 |
| Feb. 15 to March 14, | 0.875 | 0.20 | 0.50 | 2.96 | 2.10 | 1:4.7 | 0.324 | 6.93 | 8.75 |

*Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.*

| | Dry Matter. | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 76.07 pounds Buffalo gluten feed, . | 70.60 | $0 79 | $0 46 | $0 33 |
| 8.52 pounds cotton-seed meal, . | 7.98 | 0 11 | 0 09 | 0 02 |
| 129.76 pounds rowen, . . . | 115.10 | 0 97 | 0 41 | 0 56 |
| 211.80 pounds corn and soja-bean ensilage, . . . . . . | 47.08 | 0 30 | 0 12 | 0 18 |
| | 247.76 | $2 17 | $1 08 | $1 09 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, . | 70.25 lbs. |
| Live weight of animal at the end of the experiment, . . | 99.00 " |
| Live weight gained during the experiment, . . . . . | 28.75 " |
| Average gain in weight per day, . . . . . . . | 0.25 " |
| Dressed weight of animal, . . . . . . . . | – |
| Loss in weight by dressing, . . . . . . . . | – |
| Pounds of dry matter fed produced 1 pound of live weight, . | 8.37 " |
| Total cost of feed per pound of live weight gained, . . | 7.54 cts. |
| Net cost of feed per pound of live weight gained, . . | 3.78 " |

*Sheep No. 5.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Gain in Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound Live Weight. | Total Gain in Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. | | | | | |
| **1892-93.** | | | | | | | | | |
| Nov. 19 to Jan. 10, . | 0.60 | – | 1.96 | – | 2.29 | 1:5.5 | 0.332 | 6.90 | 17.25 |
| Jan. 24 to Feb. 15, . | 0.534 | 0.125 | 0.50 | 3.48 | 1.83 | 1:5.5 | 0.318 | 5.75 | 7.00 |
| Feb. 15 to March 14, | 0.875 | 0.20 | 0.50 | 2.55 | 2.01 | 1:4.6 | 0.213 | 9.44 | 5.75 |

*Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.*

| | Dry Matter. | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 76.07 pounds Buffalo gluten feed, . | 70.60 | $0 80 | $0 45 | $0 35 |
| 8.52 pounds cotton-seed meal, . | 7.98 | 0 11 | 0 09 | 0 02 |
| 133.92 pounds rowen, . . . | 118.79 | 1 00 | 0 42 | 0 58 |
| 211.66 pounds corn and soja-bean ensilage, . . . . . | 47.05 | 0 29 | 0 73 | 0 16 |
| | 244.42 | $2 20 | $1 09 | $1 11 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, . | 65.25 lbs. |
| Live weight of animal at the end of the experiment, . . | 93.50 " |
| Live weight gained during the experiment, . . . . | 28.25 " |
| Average gain in weight per day, . . . . . . | 0.25 " |
| Dressed weight of animal, . . . . . . | – |
| Loss in weight by dressing, . . . . . . | – |
| Pounds of dry matter fed produced 1 pound of live weight, . | 8.65 " |
| Total cost of feed per pound of live weight gained, . . | 7.78 cts. |
| Net cost of feed per pound of live weight gained, . . . | 3.93 " |

### *Sheep No. 6.*

| FEEDING PERIODS. | FEED CONSUMED (POUNDS) PER DAY. | | | | Dry Matter consumed per Day (Pounds). | Nutritive Ratio. | Gain in Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound Live Weight. | Total Gain in Live Weight (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| | Buffalo Gluten Feed. | Cotton-seed Meal. | Rowen. | Corn and Soja-bean Ensilage. | | | | | |
| **1892-93.** | | | | | | | | | |
| Nov. 19 to Jan. 10, . | 0.57 | – | 1.68 | – | 2.01 | 1:5.4 | 0.202 | 9.95 | 10.50 |
| Jan. 24 to Feb. 15, . | 0.534 | 0.125 | 0.50 | 3.83 | 1.90 | 1:5.6 | 0.193 | 9.83 | 4.25 |
| Feb. 15 to March 24, | 0.875 | 0.20 | 0.50 | 2.61 | 2.02 | 1:4.6 | 0.148 | 13.63 | 4.00 |

### *Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.*

| | Dry Matter. | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 74.51 pounds Buffalo gluten feed, . | 69.14 | $0 78 | $0 45 | $0 33 |
| 8.52 pounds cotton-seed meal, . | 7.98 | 0 11 | 0 09 | 0 02 |
| 119.36 pounds rowen, . . . | 104.88 | 0 90 | 0 38 | 0 52 |
| 198.23 pounds corn and soja-bean ensilage, . . . . . | 45.39 | 0 28 | 0 12 | 0 16 |
| | 227.39 | $2 07 | $1 04 | $1 03 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 64.50 lbs. |
| Live weight of animal at the end of the experiment, . . | 87.00 " |
| Live weight gained during the experiment, . . . . | 22.50 " |
| Average gain in weight per day, . . . . . . | 0.195 " |
| Dressed weight of animal, . . . . . . . | 45.25 " |
| Loss in weight by dressing, 47.93 per cent., . . . . | 41.75 " |
| Pounds of dry matter fed produced 1 pound of live weight, . | 10.11 " |
| Total cost of feed per pound of live weight gained, . . | 9.20 cts. |
| Net cost of feed per pound of live weight gained, . . | 4.58 " |

## GENERAL SUMMARY OF FEEDING EXPERIMENTS WITH GROWING LAMBS.

### 1890–93.

A series of winter feeding experiments has been carried on at the station during the past four years, 1890–93, with lambs born the previous spring.

Many spring lambs are not far enough advanced to be sold during the late summer at good prices, and are therefore fed during the fall and winter and placed in the market in the early spring.

These experiments have sought, among other things, to ascertain : —

I. (1) The average cost of feed to produce a pound of live weight.

(2) The average daily gain in live weight.

(3) The loss of weight in dressing.

(4) The dry matter required to produce a pound of live weight.

II. The effect of wide *vs.* narrow fodder rations on the gain in weight.

III. The combinations of grains and coarse fodder articles best suited to the economical production of lambs for the market.

Eighteen sheep were used in the three experiments presented. The experiment conducted in 1892 is excluded, from the fact that the results are so different from those of the other three years. The time occupied by the different experiments varied from 120 to 200 days.

The object here is simply to present a very brief *résumé* of the results, referring the reader to the respective annual reports for details.

### 1. *Cost of Production.*

[Cents.]

| | 1890. | 1891. | 1893. | Average. |
|---|---|---|---|---|
| Total cost of feed to produce one pound live weight, | 12.25 | 11.03 | 7.67 | 10.32 |
| Net cost of feed to produce one pound live weight, | 6.19 | 6.31 | 3.41 | 5.30 |

### 2. *Average Gain.*

[Pounds ]

| | 1890. | 1891. | 1893. | Average. |
|---|---|---|---|---|
| Average daily gain in live weight, | 0.19 | 0.21 | 0.27 | 0.22 |

### 3. *Shrinkage.*

[Per Cent ]

| | 1890. | 1891. | 1893. | Average. |
|---|---|---|---|---|
| Loss in weight by dressing, | 45.3 | 49.9 | 49.3 | 48.2 |

### 4. *Dry Matter.*

[Pounds ]

| | 1890. | 1891. | 1893. | Average. |
|---|---|---|---|---|
| Dry matter required to produce one pound live weight, | 13.61 | 10.04 | 7.75 | 10.47 |

II. Wide *vs.* narrow rations. During the years 1890 and 1891 the effect of feeding wide and narrow rations was tried. The wide rations contained less protein and more carbohydrates than the narrow ones.

The wide rations had a nutritive ratio of 1 : 6.84 and the narrow rations of 1 : 4.71.

The six sheep were divided into two lots of three each.

| | Nutritive Ratio. | Average Gain in Live Weight per Day (Pounds). | Total Cost of Feed per Pound Live Weight gained (Cents). | Net Cost of Feed per Pound Live Weight gained (Cents). | Dry Matter required to produce One Pound Live Weight (Pounds). |
|---|---|---|---|---|---|
| Lot I., narrow ration, | 1 : 4.71 | 0.22 | 11.30 | 5.51 | 11.35 |
| Lot II., wide ration, | 1 : 6.84 | 0.18 | 11.26 | 6.49 | 11.40 |

The cost of production of live weight is the same in each case. The narrow rations give a better quality of manure, and cause a somewhat increased growth.

## III. *Winter Fodder Rations for Growing Lambs (60 to 100 Pounds).*

The following combinations of grains and coarse fodder have proved valuable as winter fodder rations for lambs (yearlings).

In general, where corn ensilage has been substituted for one-half to two-thirds of the rowen the growth has been fully as good and the cost of production of live weight somewhat less.

| I. | |
|---|---|
| Wheat bran, | 0.50 lbs. |
| Chicago gluten meal, | 0.50 " |
| Rowen, | 2.00 " |
| Nutritive ratio, | 1 : 4.50 |
| Total cost (approximate), | 2.50 cts. |
| Manurial value obtainable, | 1.15 " |
| Net cost, | 1.36 " |

| II. | |
|---|---|
| Wheat bran, | 0.50 lbs. |
| Chicago gluten meal, | 0.50 " |
| Rowen, | 1.00 " |
| Corn ensilage, | 3.50 " |
| Nutritive ratio, | 1 : 5.09 |
| Total cost (approximate), | 2 24 cts. |
| Manurial value obtainable, | 1.10 " |
| Net cost, | 1.14 " |

| III. | |
|---|---|
| Wheat bran, | 0.50 lbs. |
| Linseed meal, | 0.25 " |
| Rowen, | 1.50 " |
| Nutritive ratio, | 1 : 4 0 |
| Total cost (approximate), | 2.08 cts. |
| Manurial value obtainable, | 1.02 " |
| Net cost, | 1.06 " |

| IV. | |
|---|---|
| Wheat bran, | 0.50 lbs. |
| Linseed meal, | 0 25 " |
| Rowen, | 0.50 " |
| Corn ensilage, | 3.50 " |
| Nutritive ratio, | 1 : 5.0 |
| Total cost (approximate), | 1.8 cts. |
| Manurial value obtainable, | 0.9 " |
| Net cost, | 0.9 " |

| V. | |
|---|---|
| Corn meal, | 0.50 lbs. |
| Cotton-seed meal, | 0.50 " |
| Rowen, | 1.50 " |
| Nutritive ratio, | 1 : 5.3 |
| Total cost (approximate), | 2 40 cts. |
| Manurial value obtainable, | 1 30 " |
| Net cost, | 1.10 " |

| VI. | |
|---|---|
| Buffalo gluten feed, | 0 75 lbs. |
| Rowen, | 2.00 " |
| Nutritive ratio, | 1 : 5.3 |
| Total cost (approximate), | 2.33 cts. |
| Manurial value obtainable, | 1.25 " |
| Net cost, | 1.07 " |

| VII. | |
|---|---|
| Buffalo gluten feed, | 0.75 lbs. |
| Cotton-seed meal, | 0.25 " |
| Rowen, | 0.50 " |
| Corn ensilage, | 4.00 " |
| Nutritive ratio, | 1 : 4.6 |
| Total cost (approximate), | 2.04 cts. |
| Manurial value obtainable, | 1.14 " |
| Net cost, | 0.90 " |

## Remarks on Above Rations.

Linseed meal, cotton-seed meal and Chicago gluten meal can be substituted one for the other without very materially changing the cost of the ration or its feeding effect. Buffalo gluten feed and Chicago maize feed can also be used interchangeably.

One-half pound of rowen and four to five pounds of corn ensilage in a ration tends to cheapen the cost and is as effective in feeding value as one and one-half to two pounds of rowen. In general, four pounds of corn ensilage can be reckoned an equivalent for one pound of rowen, so far as dry matter is concerned.

The rations as given can be increased or decreased proportionately in quantity to suit the appetite and size of the animals fed.

## General Conclusions.

The results of the three experiments during the years 1890, 1891 and 1893 with growing lambs have shown: —

1. That the average total cost of feed required to produce one pound of live weight was 10.32 cents and the net cost 5.34 cents. The selling price of live weight during these years was 6 cents per pound.

The same facts seem to hold good with sheep as with steers, viz., the coarse fodders and grains can be sold at market rates and paid for in the value of the live weight produced, and in the value of the nitrogen, phosphoric acid and potash in the manure at the current market prices for these articles.

This experiment and many others made at the station make the following point very emphatic: since the manure produced, both solid and liquid, figures so prominently in the financial results, it is extremely important that it should be carefully preserved.

2. Narrow rations, 1 : 4.7 (with a larger amount of digestible protein than the wide rations), have produced a greater gain in live weight than wide rations, 1 : 7.0.

3. The total cost of feed required to produce one pound of live weight was about the same in each case, namely, 11.30

cents and 11.26 cents per day. The net cost in case of narrow rations was 5.51 cents per day, against 6.49 cents per day for wider rations. This shows that the chief advantage of the very narrow rations in these experiments came from the increased value of the manure produced.

4. The dry matter required to produce one pound of live weight was about the same in both cases, namely, 11.35 and 11.40 pounds. With the present knowledge of animal nutrition, rations with a nutritive ratio of about 1 : 5 appear to be the most economical to feed to growing lambs, as well as to steers.

# IV.

# FEEDING EXPERIMENTS WITH PIGS (TWO).

## EIGHTEENTH EXPERIMENT.

The following experiment is a continuation of those described in previous reports of the station. In our experiments with milch cows we have had considerable quantities of skim-milk remaining after the removal of the cream, and the question has ever been as to how this milk shall be disposed of *to the best advantage.* This question is one that confronts many of the farmers of our State, from the fact that the creamery system is so generally introduced. Some farmers living near large towns have opportunity to dispose of this milk at from one to two cents per quart, and it is undoubtedly more profitable to thus dispose of it than to feed it to our farm animals. Still, to by far the larger number of farmers this opportunity does not present itself, and the milk must be utilized upon the farm by feeding it to pigs or other animals.

### OBJECT OF THIS EXPERIMENT.

The results of our previous experiments have shown that the various grains, such as corn meal, wheat bran, gluten meal and maize feed, when fed in connection with skim-milk, have furnished very excellent and profitable rations for growing young pigs for the market. The object of this experiment has been, among other things, to learn the value of Buffalo gluten feed and corn meal when fed in connection with skim-milk for the economical production of pork for the market.

The skim-milk being a very nitrogenous article of food, with a nutritive ratio of 1 to 2.15, the rations furnished the pigs were what might be termed narrow, varying from 1 : 3.3 to 1 : 5. Whether a narrow or a wide ration is better for growing and fattening pigs is still a matter of some dispute among investigators. It is certain, however, that the rations fed in our various experiments with pigs have been productive of most excellent results, and we can commend them to the serious attention of the farmers of the State.

### Description of the Experiment.

Six grade Chester White pigs, three sows and three barrows, weighing from 25 to 30 pounds each, served us for the experiment. They were kept in separate pens, and fed three times per day, namely, in the morning at six o'clock, at noon, and in the afternoon at five o'clock, with all the food they would eat up clean. It was always our object to supply them plentifully, but at the same time not to glut them, and thus in a measure destroy their appetites.

The liquid food consisted of from three to six quarts of skim-milk per day, depending upon the size of the pigs and the quantity of milk at our disposal. It never exceeded six quarts per day. The grain fed was corn meal and Buffalo gluten feed. The gluten feed, being quite rich in protein, served to keep our rations within the limits desired when the supply of skim-milk failed, and four ounces of gluten feed was in a general way reckoned equal to one quart of skim-milk.

### Number of Feeding Periods.

The experiment was divided into three distinct feeding periods. The first period continued till the pigs reached 80 pounds in weight, and the food consisted of two ounces of corn meal to every quart of milk, with a ratio of 1 : 3.3. As our supply of milk at this season was rather limited, four ounces of gluten feed was substituted for each quart of milk, and this gradually increased the ratio to 1 : 4.

The second period began when the pigs reached about 80 pounds in weight and continued till 125 pounds weight was reached. The food consisted of the skim-milk at our disposal, which varied somewhat, together with corn meal and Buffalo gluten feed, to give the desired ratio of 1 : 4.5.

The third and last period began when the pigs weighed 125 pounds and ended when 180 pounds was reached, at which time they were slaughtered. The feed consisted of skim-milk, and of a mixture of one and one-half parts corn meal and one part Buffalo gluten feed, fed in sufficient quantities to satisfy the appetite of the animals.

The following tables will, we believe, present sufficient data to enable the reader to understand the experiment and grasp the results obtained: —

| FEEDING PERIODS. | Composition of Ration. | Duration of Period. | Nutritive Ratio. |
|---|---|---|---|
| Period I., | 2 ounces corn meal to each quart milk, | 20 to 80 pounds live weight. | 1:3.3 |
| Period II., | 4 ounces corn meal to each quart milk, and 4 ounces Buffalo gluten feed as a substitute for quart milk. | 80 to 125 pounds live weight. | 1:4.5 |
| Period III., | 4 to 6 quarts milk and 1½ parts corn meal to 1 part Buffalo gluten feed to satisfy animal. | 125 to 180 pounds live weight. | 1:4.9 |

| | | AVERAGE DAILY RATIONS. | | | | Average Weekly Weight (Pounds). | Average Daily Gain (Pounds). |
|---|---|---|---|---|---|---|---|
| | | Skim-milk (Quarts). | Corn Meal (Ounces). | Gluten Feed (Ounces). | Nutritive Ratio. | | |
| Aug. 9 to Aug. 16, | Feeding Period I. | 3 | 6 | – | 1:3.3 | 27-31.2 | .59 |
| Aug. 16 to Aug. 23, | | 4 | 8 | – | | 36.5 | .76 |
| Aug. 23 to Aug. 30, | | 5 | 10 | – | | 43.9 | 1.05 |
| Aug. 30 to Sept. 6, | | 6 | 12 | – | | 49.5 | .80 |
| Sept. 6 to Sept. 13, | | 6 | 12 | – | | 56.1 | .94 |
| Sept. 13 to Sept. 20, | | 5 | 12 | 4 | | 63.0 | .99 |
| Sept. 20 to Sept. 27, | | 5 | 14 | 8 | | 71.6 | 1.23 |
| Sept. 27 to Oct. 4, | | 5 | 16 | 12 | | 80.3 | 1.24 |
| Oct. 4 to Oct. 11, | Feeding Period II. | 5 | 28 | 8 | 1:4.5 | 89.0 | 1.24 |
| Oct. 11 to Oct. 18, | | 5 | 32 | 12 | | 101.7 | 1.81 |
| Oct. 18 to Oct. 25, | | 5 | 36 | 16 | | 112.7 | 1.56 |
| Oct. 25 to Nov. 1, | | 5 | 36 | 24 | | 126.0 | 1.90 |
| Nov. 1 to Nov. 8, | Feeding Period III. | 4 | 48 | 28 | 1:4.9 | 143.0 | 2.40 |
| Nov. 8 to Nov. 15, | | 4 | 54 | 36 | | 151.7 | 2.40 |
| Nov. 15 to Nov. 22, | | 4 | 54 | 40 | | 175.2 | 2.20 |
| Nov. 22 to Nov. 28, | | 4 | 48 | 30 | | 182.8 | 1.08 |

We now wish to call attention to a summary of the results obtained : —

*Summary of Results.*

| | Average Results of Six Pigs (Pounds). |
|---|---|
| Live weight, | 182.8 |
| Dressed weight, | 144.6 |
| Per cent of loss in dressing, | 21.6 |
| Live weight gained during experiment, | 155.6 |
| Dressed weight gained during experiment, | 122.0 |
| Dry matter required to produce 1 pound live weight, | 2.27 |
| Dry matter required to produce 1 pound dressed weight, | 2.91 |

*Financial Statement.*

| | |
|---|---|
| 732.15 pounds dressed pork actually produced during the experiment, at 7¼ cents per pound, | $53 07 |
| Cost of food required, | 33 94 |
| Profit from pork actually produced, | $19 13 |
| Value of manure produced, | 9 61 |
| Total profit from six pigs, | $28 74 |
| Total profit per pig, | 4 79 |

If we take into consideration the first cost of the pigs and the dressed weight actually sold, we have the following : —

| | | |
|---|---|---|
| 867¾ pounds dressed weight actually sold at 7¼ cents, | | $62 91 |
| Total cost of food consumed, | $35 19 | |
| Cost of pigs, at $3, | 18 00 | |
| | | 53 19 |
| Total profit from pork, | | $9 72 |
| Value of manure produced, | | 10 00 |
| Total profit from six pigs, | | $19 72 |
| Total profit per pig, | | 3 29 |
| Cost of food to produce 1 pound live weight, | | 3.64 cts. |
| Cost of food to produce 1 pound dressed weight, | | 4.64 " |
| Net cost of food to produce 1 pound dressed weight (obtained by deducting value of manure produced), | | 3.30 " |

The cost of the labor required to care for the pigs during their growth, as well as the cost of preparing them for the market, has not been deducted.

### *Market Cost of Foods consumed.*

| | |
|---|---|
| Corn meal, | $24 00 per ton. |
| Buffalo gluten feed, | 23 00 per ton. |
| Skim-milk, | 1.8 cents per gallon. |

### *Percentage of the Essential Fertilizer Constituents in the Above Articles of Fodder, and the Commercial Value of the Constituents in 2,000 Pounds of the Foods.*

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

| | Corn Meal. | Gluten Feed. | Skim-milk. |
|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. |
| Moisture, | 11.38 | 6.82 | 90.50 |
| Nitrogen, | 1.80 | 3.81 | 0.52 |
| Phosphoric acid, | 0.70 | 0.30 | 0.19 |
| Potassium oxide, | 0.40 | 0.04 | 0.20 |
| Valuation per 2,000 pounds, | $6 53 | $11 81 | $1 95 |
| *Obtainable manurial value per ton, | 4 57 | 8 28 | 1 36 |

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* Allowing that thirty per cent of the nitrogen, potash and phosphoric acid is retained in the system of the growing animal.

## NINETEENTH FEEDING EXPERIMENT WITH PIGS.

*December, 1892, to April, 1893.*

Six pigs were used in this experiment. They were divided into two lots of three each, and both lots were fed for the first ten days upon skim-milk and corn meal till they became accustomed to their new quarters. Pigs 1 and 4 were barrows, and Nos. 2, 3, 5 and 6 were sows. The pigs came from a Chester White sow, but as they grew Nos. 2, 3 and 6 showed plainly the Yorkshire characteristics. The general mode of treatment was quite similar to that described in the preceding experiment.

### Object of the Experiment.

The object of the experiment was: First, a continuation of the many preceding experiments, in order to firmly establish facts relative to the most economical method of feeding skim-milk in combination with various grains and new concentrated fodder articles; in this case the experiment with Buffalo gluten feed was continued. Second, a step was taken in the direction of comparing the relative value of wide *vs.* narrow rations for economical pork production. In the many experiments heretofore made at this station, the general mode of feeding has been what might be termed narrow, *i. e.*, large quantities of nitrogenous matter in proportion to the non-nitrogenous and starchy matter have been fed. The feeding has generally begun with a ration of one part nitrogenous to three parts non-nitrogenous (1 : 3), and has been twice increased during the later feeding periods, till in the last of the three periods (in which the animal has increased in weight from 125 to 180 pounds) the ratio has been one part nitrogenous to four and one-half parts non-nitrogenous (1 : 4.5). Only in one or two cases have wider rations been fed. This method of feeding has been productive of most excellent results. The skim-milk has been most economically utilized, the animals have possessed uniformly good health and the pork has been produced at a comparatively low cost.

In case of three pigs in the present experiment wider rations were fed, beginning with 1 : 4.25 and ending with 1 : 6.5.

From the results obtained in this one experiment no very accurate conclusions can be drawn. What the experiment indicates can be seen from the figures presented further on, and it will be alluded to under our heading of "What our experiments teach us."

Experiments of this kind will be repeated, we hope, *in order to illustrate to our farmers* whether it is more economical to feed young growing pigs (from 25 to 180 pounds) in the beginning rations containing one part of nitrogenous to three parts non-nitrogenous matter (1 : 3), and ending with one part nitrogenous to four and one-half parts non-nitrogenous (1 : 4.5), or whether they can be fed as well or better with rations beginning with one part nitrogenous to four and one-half parts non-nitrogenous (1 : 4.5), and ending with one part nitrogenous to six and one-half parts non-nitrogenous (1 : 6.5).

## HOW THE SIX PIGS WERE TREATED IN THE PRESENT EXPERIMENT.

The pigs were divided into two lots of three each. Lot I., consisting of pigs 1, 2 and 3, was treated in practically the same way as in our previously described experiment. We had during a portion of the time a good supply of skim-milk, and each pig in this lot received at one time as high as ten quarts per day, in addition to his grain feed. The grain consisted of corn meal, and four ounces of Buffalo gluten feed as a substitute for one quart of milk, when the supply of the latter was limited. In case of Lot II. the number of feeding periods was the same, namely, three. During the first period the pigs were fed six ounces of corn meal to each quart of milk, and this continued until the pigs had reached a weight of 80 pounds, and were consuming four and one-half quarts of milk and twenty-seven ounces of corn meal per day. In periods II. and III. the supply of milk was kept at four quarts daily, plus two quarts of water to give the necessary drink, and as much corn meal was added as the animals would consume.

The following tables will, we believe, present concisely and clearly our method of feeding and the results obtained: —

*Lot I.*

| FEEDING PERIODS. | Composition of Ration. | Duration of Period. | Nutritive Ratio. |
|---|---|---|---|
| Period I., . | 2 ounces corn meal to each quart milk, . | 27 to 75 pounds live weight. | 1:3 |
| Period II., . | 4 ounces corn meal to each quart milk, and 4 ounces gluten feed as a substitute for each quart milk. | 75 to 120 pounds live weight. | 1:3.6 |
| Period III., | 6 ounces corn meal to each quart milk, and 4 ounces gluten feed as a substitute for each quart milk. | 120 to 175 pounds live weight. | 1:4.5 |

In Period II. of Lot I. we fed as high as ten quarts of skim-milk per day in addition to grain, while in Period III. the quantity of skim-milk, because of the limited supply, was reduced to four or five quarts per day.

*Lot II.*

| FEEDING PERIODS. | Composition of Ration. | Duration of Period. | Nutritive Ratio. |
|---|---|---|---|
| Period I., . | 6 ounces corn meal to each quart milk, . | 27 to 80 pounds live weight. | 1:4.2 |
| Period II., . | 4 quarts skim-milk and 2 quarts water, and corn meal *ad libitum.* | 80 to 120 pounds live weight. | 1:5.3 |
| Period III., | 4 quarts skim-milk and 2 quarts water, and corn meal *ad libitum.* | 125 to 180 pounds live weight. | 1:6.5 |

### SUMMARY OF RESULTS.

The experiment lasted one hundred and twenty-six days, and was productive of the following average results: —

*Average Daily Gain.*

| | Period I. (Pounds). | Period II. (Pounds). | Period III. (Pounds). | Daily Average of One Hundred and Twenty-six Days (Pounds). |
|---|---|---|---|---|
| Lot I., . . . . | 84 | 1.33 | 1.50 | 1.22 |
| Lot II., . . . . | .92 | 1.30 | 1.60 | 1.27 |

| | LOT I. Average of Three Pigs (Pounds). | LOT II. Average of Three Pigs. (Pounds). |
|---|---|---|
| Live weight, . . . . . . . . | 172.71 | 180.75 |
| Dressed weight, . . . . . . . . | 140.75 | 148.00 |
| Per cent. of loss in dressing, . . . . . | 18.53% | 18.10% |
| Live weight gained during experiment, . . | 146.17 | 152.00 |
| Dressed weight gained during experiment, . | 119.16 | 122.47 |
| Dry matter required to produce 1 pound live weight, . . . . . . . . . . | 2.82 | 2.57 |
| Dry matter required to produce 1 pound dressed weight, . . . . . . . . . | 3.45 | 3.18 |

No difference in the amount of intestinal fat was observed in either lot.

*Financial Statements.*

*No. I.*

| | Lot I. | Lot II. |
|---|---|---|
| Dressed pork actually produced during experiment (pounds), . . . . . . . | 357.5 | 367.4 |
| Value at 7¾ cents per pound (market price), . | $27 71 | $28 47 |
| Cost of food consumed, . . . . . . | 19 95 | 18 02 |
| Profit from pork actually produced, . . . . | $7 76 | $10 45 |
| Value of manure produced, . . . . . | 6 05 | 4 41 |
| Total profit from three pigs, . . . . . | $13 81 | $14 86 |
| Profit per pig, . . . . . . . . | 4 60 | 4 95 |

If we take into consideration the first cost of the pigs and the dressed weight actually sold, we have the following record for both lots : —

*No. II.*

| | | |
|---|---|---|
| 866.25 pounds dressed pork actually sold, at 7¾ cents, . . . | | $67 13 |
| Total cost of food consumed, . . . . . . | $39 05 | |
| Cost of pigs, at $2.25 each, . . . . . . . | 13 50 | |
| | | 52 55 |
| Profit from pork, . . . . . . . . . . . . | | $14 58 |
| Value of manure produced, . . . . . . . . . | | 11 38 |
| Total profit from six pigs, . . . . . . . . . | | $25 96 |
| Profit per pig, . . . . . . . . . . . . . | | 4 33 |

| | Lot I. (Cents). | Lot II. (Cents). |
|---|---|---|
| Cost of food to produce 1 pound live weight, . . | 4.55 | 3.95 |
| Cost of food to produce 1 pound dressed weight, . | 5.58 | 4.91 |
| Net cost of food to produce 1 pound dressed weight (obtained by deducting value of manure produced from cost of food), . . . . . . . . | 3.88 | 3.90 |

*Market Cost of Foods consumed.*

| | |
|---|---|
| Corn meal, . . . . . . . . . . . | $23 00 per ton. |
| Gluten feed, . . . . . . . . . . . | 21 00 per ton. |
| Skim-milk, . . . . . . . . . | 1.8 cents per gallon. |

The *percentages* of the essential fertilizer constituents in the above articles of fodder, their *commercial value* in 2,000 pounds, as well as their approximate *obtainable manurial value* when fed to growing pigs, may be seen from the following : —

[Nitrogen at 17½ cents, phosphoric acid at 5 cents, and potassium oxide at 5½ cents, per pound.]

| | Per Cent. | Per Cent. | Per Cent. |
|---|---|---|---|
| Moisture, . . . . . . . . | 14.00 | 7.55 | 90.24 |
| Nitrogen, . . . . . . . . | 1.36 | 3.55 | .51 |
| Phosphoric acid, . . . . . | .707 | .296 | .18 |
| Potash, . . . . . . . . | .435 | .045 | .19 |
| Valuation per 2,000 pounds, . . | $5 95 | $12 70 | $2 17 |
| Obtainable manurial value, . . | 4 17 | 8 89 | 1 52 |

## What our Experiments teach.

Briefly stated, from a practical stand-point, these two experiments and many others made at the station teach us the following lessons: —

I. Skim-milk, together with corn meal, gluten meal, wheat bran, gluten feed, maize feed, etc., combined as above stated, have proved healthy and profitable foods for the production of pork for our markets.

II. With skim-milk reckoned at 1.8 cents per gallon, gluten feed from $21 to $23 per ton and corn meal at $23 to $24 per ton, we have been enabled in these experiments to produce dressed pork at from 4.6 to 5.3 cents per pound. The net cost of the dressed pork produced (obtained by deducting the value of the manure produced) was from 3.3 to 3.8 cents per pound.

III. Farmers having a quantity of skim-milk at their disposal can utilize it profitably by feeding it to growing pigs, as above described. If this milk can be sold, however, at one cent per quart, or more, it would undoubtedly be more profitable to sell it than to use it in the production of pork.

IV. Experiments made at this station have proved that it is not profitable to feed pigs after they reach a weight of 180 to 190 pounds, excepting perhaps when pork commands an exceptionally high price. Fed beyond this weight, the food consumed increases and the percentage of gain in live weight steadily decreases, so that the daily cost of food consumed is more than the value of the daily increase in weight. This fact has since been confirmed by other stations.

V. In the last experiment, Lot II. gave slightly more favorable results than Lot I. These results are not decisive enough to enable us to make any deductions, especially when the results of previous experiments at this station with narrow rations, and experiments elsewhere with both wide and narrow rations, are considered. Repeated trials are necessary to establish facts.

## Practical Rations for Pig Feeding.

When skim-milk is used as a part of the daily diet in feeding pigs for the market, the station feels justified, in view of its feeding experiments, in recommending the following practical rations as being valuable in producing pork at a minimum cost: —

I.

| Weight of Pigs (Pounds). | Food. | Nutritive Ratio. |
|---|---|---|
| 20 to 80, . | 2 ounces corn meal to each quart milk,* . | 1:3.30 |
| 80 to 125, . | 4 ounces corn meal to each quart milk, . . | 1:4.00 |
| 125 to 190, . | 6 ounces corn meal to each quart milk, . . | 1:4.50 |

* Creamery buttermilk can be substituted for skim-milk as above with good results if it can be had at a reasonable price, say 1.4 cents per gallon.

When skim-milk is in limited supply, from four to six quarts per pig.

II.

| Weight of Pigs (Pounds). | Food. | Nutritive Ratio. |
|---|---|---|
| 20 to 80, . | Milk at disposal, and one part by weight wheat bran, two parts by weight gluten meal, to satisfy appetite. | 1:3.20 |
| 80 to 120, . | Milk at disposal and following mixture: one weight part corn meal, one weight part wheat bran, one weight part gluten meal, to satisfy animal. | 1:4.00 |
| 125 to 190, . | Milk at disposal and following mixture: two weight parts corn meal, one weight part wheat bran, one weight part gluten meal. | 1:4.50 |

III.

| Weight of Pigs (Pounds). | Food. | Nutritive Ratio. |
|---|---|---|
| 20 to 80, . | 2 ounces corn meal to each quart of milk and 4 ounces gluten feed as a substitute for each quart milk. | 1:3.25 to 4.00 |
| 80 to 120, . | 6 quarts skim-milk and a mixture of one part by weight gluten feed and one part by weight corn meal. | 1:4.00 to 4.40 |
| 125 to 190, . | 6 quarts skim-milk and a mixture of one part by weight gluten feed and one and one-half parts by weight corn meal. | 1:4.4 to 4.9 |

## ANALYSIS OF FODDER ARTICLES USED IN OUR PIG-FEEDING EXPERIMENTS.

### *Corn Meal.*

*Average Analysis.*

| | USED IN 18TH EXPERIMENT. | | USED IN 19TH EXPERIMENT. | | Per Cent. of Digestibility of Constituents of Corn Meal. |
|---|---|---|---|---|---|
| | Percentage Composition. | Nutritive Ratio. | Percentage Composition. | Nutritive Ratio. | |
| Moisture at 100° C., . . . | 11.38 | – | 14.00 | – | – |
| Dry matter, . . . . | 88.62 | – | 86.00 | – | – |
| | 100.00 | – | 100.00 | – | – |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, . . . . . | 1.63 | 1 : 10.65 | 1.50 | 1 : 10.00 | – |
| “ cellulose, . . . | 2.13 | | 2.58 | | 40 |
| “ fat, . . . . . | 4.63 | | 2.44 | | 76 |
| “ protein, . . . . | 10.71 | | 9.87 | | 86 |
| Non-nitrogenous extract matter, | 80.90 | | 83.61 | | 95 |
| | 100.00 | | 100.00 | | – |

### *Buffalo Gluten Feed.*

*Average Analysis.*

| | USED IN 18TH EXPERIMENT. | | USED IN 19TH EXPERIMENT. | | Per Cent of Digestibility of Constituents of Gluten Feed. |
|---|---|---|---|---|---|
| | Percentage Composition. | Nutritive Ratio. | Percentage Composition. | Nutritive Ratio. | |
| Moisture at 100° C., | 6.82 | – | 7.55 | – | – |
| Dry matter, | 93.18 | – | 92.45 | – | – |
| | 100.00 | – | 100.00 | – | – |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 0.83 | 1 : 3.46 | 0.85 | 1 : 3.80 | – |
| " cellulose, | 4.94 | | 10.06 | | 40 |
| " fat, | 13.03 | | 12.48 | | 76 |
| " protein, | 28.71 | | 23.86 | | 86 |
| Non-nitrogenous extract matter, | 52.49 | | 52.75 | | 95 |
| | 100.00 | | 100.00 | | – |

### *Skim-milk.*

*Average Analysis.*

| | USED IN 18TH EXPERIMENT. | | USED IN 19TH EXPERIMENT. | | Per Cent. of Digestibility of Constituents of Skim-milk. |
|---|---|---|---|---|---|
| | Percentage Composition. | Nutritive Ratio. | Percentage Composition. | Nutritive Ratio. | |
| Moisture at 100° C., | 90.50 | – | 90.24 | – | – |
| Dry matter, | 9.50 | – | 9.76 | – | – |
| | 100.00 | – | 100.00 | – | – |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.82 | 1 : 2.15 | 8.09 | 1 : 1.93 | – |
| " fat, | 4.00 | | 2.66 | | 100 |
| " protein, | 31.50 | | 32.66 | | 100 |
| Non-nitrogenous extract matter, | 57.68 | | 56.59 | | 100 |
| | 100.00 | | 100.00 | | – |

## EIGHTEENTH EXPERIMENT.

### Detailed Record.

*Pig No. 1.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts). | Gluten Feed consumed (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892.** | | | | | | | |
| Aug. 9 to Oct. 4, . | 38.25 | 268.00 | 9.50 | 1 : 3.37 | 25.50 | 78.00 | 0.94 |
| Oct. 4 to Nov. 1, . | 58.00 | 140.00 | 26.63 | 1 : 4.47 | 78.00 | 126.00 | 1.71 |
| Nov. 1 to Nov. 29, . | 91.88 | 113.00 | 62.31 | 1 : 4.81 | 126.00 | 182.50 | 2.02 |

*Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.*

| | Dry Matter (Pounds). | Total Cost | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 188.13 pounds corn meal, . . | 161.77 | $2 26 | $0 42 | $1 84 |
| 521.00 quarts skim-milk, . . | 107.63 | 2 34 | 0 77 | 1 57 |
| 98.44 pounds gluten feed, . . | 91.67 | 1 13 | 0 43 | 0 70 |
| | 361.07 | $5 73 | $1 62 | $4 11 |

| | | |
|---|---|---|
| Live weight of animal at the beginning of the experiment, | 25.50 | lbs. |
| Live weight of animal at the time of killing, . . . | 182.50 | " |
| Live weight gained during the experiment, . . . . | 157.00 | " |
| Dressed weight of animal, . . . . . . . . | 143.00 | " |
| Loss in weight by dressing, 21.64 per cent, . . . . | 39.50 | " |
| Dressed weight gained during the experiment, . . . | 123.02 | " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.30 | " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . . . | 2.94 | " |
| Total cost of feed per pound of dressed weight gained, . | 4.66 | cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, . . . . | 3.35 | " |

*Pig No. 2.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts). | Gluten Feed consumed (Pounds) | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892.** | | | | | | | |
| Aug. 9 to Oct. 4, . | 38.25 | 268.00 | 9.50 | 1 : 3.37 | 28.50 | 81.00 | 0.94 |
| Oct. 4 to Nov. 1, . | 58.00 | 140.00 | 26.63 | 1 : 4.47 | 81.00 | 127.75 | 1.67 |
| Nov. 1 to Nov. 29, . | 85.25 | 113.00 | 55.50 | 1 : 4.85 | 127.75 | 183.75 | 2.00 |

*Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 181.50 pounds corn meal, . . | 156.07 | $2 18 | $0 41 | $1 77 |
| 521.00 quarts skim-milk, . . | 107.63 | 2 34 | 0 77 | 1 57 |
| 91.63 pounds gluten feed, . . | 85.38 | 1 05 | 0 41 | 0 64 |
| | 349.08 | $5 57 | $1 59 | $3 98 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 28.50 lbs. |
| Live weight of animal at the time of killing, . . . | 183.75 " |
| Live weight gained during the experiment, . . . . | 155.25 " |
| Dressed weight of animal, . . . . . . . | 145.25 " |
| Loss in weight by dressing, 24.80 per cent, . . . . | 38.50 " |
| Dressed weight gained during the experiment, . . . | 116.75 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.25 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . . | 2 98 " |
| Total cost of feed per pound of dressed weight gained, . | 4.77 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, . . . . | 3.41 " |

### *Pig No. 3.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts). | Gluten Feed consumed (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892.** | | | | | | | |
| Aug. 9 to Oct. 4, . | 38.25 | 268.00 | 9.50 | 1 : 3.37 | 30.50 | 84.00 | 0.96 |
| Oct. 4 to Nov. 1, . | 58.00 | 140.00 | 26.63 | 1 : 4.47 | 84.00 | 130.00 | 1.67 |
| Nov. 1 to Nov. 29, . | 88.75 | 113.00 | 57.69 | 1 : 4.94 | 130.00 | 183.75 | 1.92 |

*Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 185.00 pounds corn meal, . . | 159.08 | $2 23 | $0 42 | $1 81 |
| 521.00 quarts skim-milk, . . | 107.63 | 2 34 | 0 77 | 1 57 |
| 93.82 pounds gluten feed, . . | 87.42 | 1 08 | 0 41 | 0 67 |
| . | 354.13 | $5 65 | $1 60 | $4 05 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 30.50 lbs. |
| Live weight of animal at the time of killing, . . . | 183.75 " |
| Live weight gained during the experiment, . . . . | 153.25 " |
| Dressed weight of animal, . . . . . . . | 144.50 " |
| Loss in weight by dressing, 21.36 per cent, . . . . | 39.25 " |
| Dressed weight gained during the experiment, . . . | 119.68 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.31 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . | 2.96 " |
| Total cost of feed per pound of dressed weight gained, . | 4.72 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, . . . . | 3.38 " |

*Pig No. 4.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts). | Gluten Feed consumed (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892.** | | | | | | | |
| Aug. 9 to Oct. 4, . | 38.25 | 268.00 | 9.50 | 1:3.37 | 24.00 | 82.00 | 1.04 |
| Oct. 4 to Nov. 1, . | 58.00 | 140.00 | 26.63 | 1:4.47 | 82.00 | 125.00 | 1.54 |
| Nov. 1 to Nov. 29, . | 88.88 | 113.00 | 58.00 | 1:4.94 | 125.00 | 181.50 | 2.02 |

*Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 185.13 pounds corn meal, . . | 159.19 | $2 23 | $0 42 | $1 81 |
| 521.00 quarts skim-milk, . . | 107.63 | 2 34 | 0 77 | 1 57 |
| 94.13 pounds gluten feed, . . | 87.71 | 1 09 | 0 41 | 0 68 |
| | 354.53 | $5 66 | $1 60 | $4 06 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 24.00 lbs. |
| Live weight of animal at the time of killing, . . . | 181.50 " |
| Live weight gained during the experiment, . . . . | 157.50 " |
| Dressed weight of animal, . . . . . . . . | 144.00 " |
| Loss in weight by dressing, 20.66 per cent, . . . . | 37.50 " |
| Dressed weight gained during the experiment, . . . | 124.97 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.25 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . . | 2.84 " |
| Total cost of feed per pound of dressed weight gained, . | 4.53 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, . . . . | 3.28 " |

### *Pig No. 5.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts). | Gluten Feed consumed (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892.** | | | | | | | |
| Aug. 9 to Oct. 4, . | 38.25 | 268.00 | 9.50 | 1:3.37 | 24.50 | 75.75 | 0.92 |
| Oct. 4 to Nov. 1, . | 58.00 | 140.00 | 26.63 | 1:4.47 | 75.75 | 124.75 | 1.75 |
| Nov. 1 to Nov. 29, . | 90.00 | 113.00 | 59.56 | 1:4.94 | 124.75 | 182.25 | 2.05 |

### *Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 186.25 pounds corn meal, . . | 160.16 | $2 23 | $0 42 | $1 81 |
| 521.00 quarts skim-milk, . . | 107.63 | 2 34 | 0 77 | 1 57 |
| 95.69 pounds gluten feed, . . | 89.16 | 1 10 | 0 41 | 0 69 |
| | 356.95 | $5 67 | $1 60 | $4 07 |

| | | |
|---|---|---|
| Live weight of animal at the beginning of the experiment, | 24.50 | lbs. |
| Live weight of animal at the time of killing, . . . . | 182.25 | " |
| Live weight gained during the experiment, . . . . . | 157.75 | " |
| Dressed weight of animal, . . . . . . . . . | 144.00 | " |
| Loss in weight by dressing, 20.98 per cent, . . . . | 38.25 | " |
| Dressed weight gained during the experiment, . . . . | 124.73 | " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.26 | " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . . | 2.88 | " |
| Total cost of feed per pound of dressed weight gained, . | 4.55 | cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, . . . . | 3.21 | " |

*Pig No. 6.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts). | Gluten Feed consumed (Pounds). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892.** | | | | | | | |
| Aug. 9 to Oct. 4, . | 38.25 | 268.00 | 9.50 | 1:3.37 | 30.00 | 81.00 | 0.91 |
| Oct. 4 to Nov. 1, . | 58.00 | 140.00 | 26.63 | 1:4.47 | 81.00 | 124.00 | 1.54 |
| Nov. 1 to Nov. 29, . | 89.37 | 113.00 | 58.75 | 1:4.94 | 124.00 | 183.00 | 2.11 |

*Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable | Net Cost. |
|---|---|---|---|---|
| 185.62 pounds corn meal, . . | 159.61 | $2 23 | $0 42 | $1 81 |
| 521.00 quarts skim-milk, . . | 107.63 | 2 34 | 0 77 | 1 57 |
| 94.88 pounds gluten feed, . . | 88.41 | 1 09 | 0 41 | 0 68 |
| | 355.65 | $5 66 | $1 60 | $4 06 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 30.00 lbs. |
| Live weight of animal at the time of killing, . . . | 183.00 " |
| Live weight gained during the experiment, . . . . | 153.00 " |
| Dressed weight of animal, . . . . . . . | 147.00 " |
| Loss in weight by dressing, 19.67 per cent, . . . . | 36.00 " |
| Dressed weight gained during the experiment, . . . | 1.23 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.32 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . | 2.88 " |
| Total cost of feed per pound of dressed weight gained, . | 4.60 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, . . . . | 3.26 " |

## NINETEENTH EXPERIMENT.

### Detailed Record.

*Pig No. 1.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Gluten Feed consumed (Pounds). | Skim-milk consumed (Quarts). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892-93.** | | | | | | | |
| Dec. 13 to Feb. 7, | 43.25 | 6.25 | 321.00 | 1 : 3.00 | 27.50 | 77.00 | 0.88 |
| Feb. 7 to Mar. 14, | 49.00 | 33.25 | 198.00 | 1 : 3.65 | 77.00 | 122.50 | 1.28 |
| Mar. 14 to Apr. 18, | 120.00 | 27.81 | 247.00 | 1 : 4.50 | 122.50 | 175.00 | 1.53 |

*Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 212.25 pounds corn meal, . . | 182.54 | $2 44 | $0 44 | $2 00 |
| 67.31 pounds gluten feed, . . | 62.23 | 0 71 | 0 30 | 0 41 |
| 766.00 quarts skim-milk, . . | 162.23 | 3 45 | 1 26 | 2 19 |
| | 407.00 | $6 60 | $2 00 | $4 60 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 27.50 lbs. |
| Live weight of animal at the time of killing, . . . . | 175.00 " |
| Live weight gained during the experiment, . . . . | 147.50 " |
| Dressed weight of animal, . . . . . . . . | 144.00 " |
| Loss in weight by dressing, 17.95 per cent., . . . . | 31.50 " |
| Dressed weight gained during the experiment, . . . | 121.45 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.78 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . . | 3.35 " |
| Total cost of feed per pound of dressed weight gained, . | 5.43 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, . . . . | 3.79 " |

*Pig No. 2.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Gluten Feed consumed (Pounds). | Skim-milk consumed (Quarts). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892-93.** | | | | | | | |
| Dec. 13 to Feb. 7, | 43.25 | 6.25 | 321.00 | 1 : 3.00 | 25.25 | 69.50 | 0.79 |
| Feb. 7 to Mar. 14, | 51.50 | 35.00 | 206.00 | 1 : 3.65 | 69.50 | 113.50 | 1.26 |
| Mar. 14 to Apr. 18, | 126.89 | 30.81 | 253.00 | 1 : 4.50 | 113.50 | 176.00 | 1.78 |

*Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 221.64 pounds corn meal, . . | 190.61 | $2 55 | $0 46 | $2 09 |
| 74.56 pounds gluten feed, . . | 68.93 | 0 72 | 0 33 | 0 39 |
| 780.00 quarts skim-milk, . . | 165.20 | 3 51 | 1 28 | 2 23 |
| | 424.74 | $6 78 | $2 07 | $4 71 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 25.25 lbs. |
| Live weight of animal at the time of killing, . . . . | 176.00 " |
| Live weight gained during the experiment, . . . . . | 150.75 " |
| Dressed weight of animal, . . . . . . . . | 140.00 " |
| Loss in weight by dressing, 20.45 per cent., . . . . . | 36.00 " |
| Dressed weight gained during the experiment, . . . . | 119.92 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.82 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . . | 3.54 " |
| Total cost of feed per pound of dressed weight gained, . | 5.65 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, . . . . . | 3.93 " |

*Pig No. 3.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Gluten Feed consumed (Pounds). | Skim-milk consumed (Quarts). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|
| **1892-93.** | | | | | | | |
| Dec. 13 to Feb. 7, | 43.25 | 6.25 | 318.00 | 1 : 3.00 | 26.75 | 77.75 | 0.91 |
| Feb. 7 to Mar. 14, | 51.50 | 35.00 | 206.00 | 1 : 3.60 | 77.75 | 125.25 | 1.36 |
| Mar. 14 to Apr. 18, | 111.50 | 21.75 | 251.00 | 1 : 4.40 | 125.25 | 167.00 | 1.19 |

*Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 206.25 pounds corn meal, . . | 177.36 | $2 37 | $0 43 | $1 94 |
| 63.00 pounds gluten feed, . . | 58.24 | 0 66 | 0 28 | 0 38 |
| 775.00 quarts skim-milk, . . | 164.14 | 3 49 | 1 27 | 2 22 |
| | 399.74 | $6 52 | $1 98 | $4 54 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 26.75 lbs. |
| Live weight of animal at the time of killing, . . . | 167.00 " |
| Live weight gained during the experiment, . . . . | 140.25 " |
| Dressed weight of animal, . . . . . . . . | 138.25 " |
| Loss in weight by dressing, 17.22 per cent., . . . . | 28.75 " |
| Dressed weight gained during the experiment, . . . | 116.11 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.85 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . . | 3.45 " |
| Total cost of feed per pound of dressed weight gained, . | 5.61 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, . . . . | 3.91 " |

*Pig No. 4.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|
| **1892-93.** | | | | | | |
| Dec. 13 to Feb. 7, | 75.38 | 201.00 | 1 : 4.20 | 30.00 | 81.00 | 0.91 |
| Feb. 7 to Mar. 14, | 98.13 | 140.00 | 1 : 5.30 | 81.00 | 127.00 | 1.30 |
| Mar. 14 to Apr. 18, | 172.50 | 138.00 | 1 : 6.50 | 127.00 | 188.00 | 1.74 |

*Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 346.00 pounds corn meal, . . | 297.56 | $3 98 | $0 72 | $3 26 |
| 479.00 quarts skim-milk, . . | 101.45 | 2 15 | 0 78 | 1 37 |
| | 399.01 | $6 13 | $1 50 | $4 63 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 30.00 lbs. |
| Live weight of animal at the time of killing, . . . | 188.00 " |
| Live weight gained during the experiment, . . . . | 158.00 " |
| Dressed weight of animal, . . . . . . . . | 150.50 " |
| Loss in weight by dressing, 20.00 per cent., . . . . | 37.50 " |
| Dressed weight gained during the experiment, . . . | 120.51 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.52 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . | 3.31 " |
| Total cost of feed per pound of dressed weight gained, . | 5.09 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, . . . . | 3.84 " |

### *Pig No. 5.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts). | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds) |
|---|---|---|---|---|---|---|
| **1892-93.** | | | | | | |
| Dec. 13 to Feb. 7, | 75.38 | 201.00 | 1:4.20 | 26.25 | 81.00 | 0.98 |
| Feb. 7 to Mar. 14, | 97.88 | 139.00 | 1:5.30 | 81.00 | 126.00 | 1.30 |
| Mar. 14 to Apr. 18, | 162.44 | 137.00 | 1:6.45 | 126.00 | 173.00 | 1.34 |

### *Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 335.70 pounds corn meal, . . | 288.70 | $3 86 | $0 69 | $3 17 |
| 477.00 quarts skim-milk, . . | 101.02 | 2 14 | 0 78 | 1 36 |
| | 389.72 | $6 00 | $1 47 | $4 53 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 26.25 lbs. |
| Live weight of animal at the time of killing, . . . | 173.00 " |
| Live weight gained during the experiment, . . . . | 146.75 " |
| Dressed weight of animal, . . . . . . . | 143.50 " |
| Loss in weight by dressing, 17.05 per cent., . . . . | 29.50 " |
| Dressed weight gained during the experiment, . . . | 121.73 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.66 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . | 3.20 " |
| Total cost of feed per pound of dressed weight gained, . | 4.93 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, . . . . | 3.72 " |

*Pig No. 6.*

| FEEDING PERIODS. | Corn Meal consumed (Pounds). | Skim-milk consumed (Quarts) | Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|
| **1892-93.** | | | | | | |
| Dec. 13 to Feb. 7, | 75.38 | 201.00 | 1:4.20 | 30.00 | 76.00 | 0.82 |
| Feb. 7 to Mar. 14, | 93.38 | 132.00 | 1:5.30 | 76.00 | 121.50 | 1.30 |
| Mar. 14 to Apr. 18, | 157.68 | 138.00 | 1:6.40 | 121.50 | 181.25 | 1.71 |

*Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. | Net Cost. |
|---|---|---|---|---|
| 326.44 pounds corn meal, . . | 280.74 | $3 76 | $0 67 | $3 09 |
| 471.00 quarts skim-milk, . . | 99.75 | 2 12 | 0 77 | 1 35 |
| | 380.49 | $5 88 | $1 44 | $4 44 |

| | |
|---|---|
| Live weight of animal at the beginning of the experiment, | 30.00 lbs. |
| Live weight of animal at the time of killing, . . . | 181.25 " |
| Live weight gained during the experiment, . . . . | 151.25 " |
| Dressed weight of animal, . . . . . . . . | 150.00 " |
| Loss in weight by dressing, 17.24 per cent., . . . . | 31.25 " |
| Dressed weight gained during the experiment, . . . | 125.17 " |
| Pounds of dry matter fed produced 1 pound of live weight, | 2.52 " |
| Pounds of dry matter fed produced 1 pound of dressed weight, . . . . . . . . . . . . | 3.04 " |
| Total cost of feed per pound of dressed weight gained, . | 4.70 cts. |
| Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, . . . . | 3.55 " |

# V.

# FEEDING EXPERIMENTS WITH CALVES.

One of the chief sources of profit to Massachusetts farmers is the dairy industry. The creamery system is now generally in vogue, and there remains upon the farms the skim-milk, the cream having been taken to the factory. How to economically utilize this milk is a very important question, for upon its disposition depends in no small degree the profit or loss from the herd of cows.

## Object of the Experiment.

For a number of years experiments have been carried on at the station with growing pigs. The pigs were fed the skim-milk in combination with various grain rations, and one of the objects aimed at was to ascertain the returns per quart for the skim-milk fed. Further on will be found a statement of the results obtained on the basis of the different selling prices of dressed pork.

With the facts in hand, the next object was to see *what price could be obtained per quart for the skim-milk when fed to young calves*, either alone or in combination with various other materials. Following these brief remarks is a description of the experiment.

## Description of the Experiment.

A detailed statement of the record of each calf will be found at the end of the experiment. Calves Nos. 1, 2, 3 and 4 were fed for the first seven to ten days equal parts of fresh and skim milk; then they were quickly brought to a skim-milk diet exclusively. The milk was always given lukewarm. After the first few weeks, in addition to the milk various grains were fed *ad libitum*, and with one exception in a dry state. It is well known that the stomachs of young calves are exceedingly delicate. During the first two months of their lives they are not able to digest any large quantities of grain; but if the grain is placed before them in a dry state, they will not consume enough to injure them. Beginning with one-fourth of a pound per day, the calves consumed as high as one pound daily by the time they were eight weeks old. These calves drank ten to twelve quarts of milk daily in addition to the grain consumed. The object in feeding the grain was to furnish in a measure the carbohydrates necessary to prevent the rapid destruction of the albuminoids in the animal system that would otherwise follow.

Skim-milk has a nutritive ratio of about 1:2. With a ratio of but two carbohydrates to one of protein, it would not be possible to produce any amount of fat; neither is a feed with such a narrow ratio the most economical one. The calves, however, were not able to consume grain enough to widen the ratio sufficiently to enable them to put on the fat desired.

Scours were noticed in case of calves 2 and 3, which prevented the best results, but the trouble was eventually overcome.

Calves Nos. 5, 6 and 7, with the exception of the first ten days, when equal parts of whole and skim milk were fed, had no other food than skim-milk during the entire experiment. Calf 5, however, for a brief period received a small amount of grain, and calf 7 a small quantity of cod liver oil, to see if any benefit could be observed from its use, both from its general effect upon the system and from its fat-producing qualities. A small quantity (tablespoonful) of lime water was added to the skim-milk at each feeding.

At the beginning of the experiment they consumed six quarts of milk daily, while at the end, with skim-milk as an exclusive food, they drank from sixteen to twenty quarts per day.

The time required to teach the calves to drink was about three days. The calves were kept in separate pens, and weighed weekly. They were kept until they were eight to eleven weeks old.

## RECORD OF CALVES.

*Showing Price per Quart obtained for Skim-milk fed.*

### CALF 1.

Age when received: three days.

Breed: grade Shorthorn, bull

Grain stirred into the milk.

Foods fed: equal parts of whole milk and skim-milk for the first few days, then skim-milk only, with as much corn meal as the animal would consume.

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of calf, | $1 00 | – |
| 55.2 pounds corn meal, at $23 per ton, | 0 63 | – |
| 10 quarts fresh milk, at 3 cents, | 0 30 | – |
| 177 pounds live weight, at 4½ cents, | – | $7 96 |
| 489 quarts skim-milk returned, | 6 03 | – |
| | $7 96 | $7 96 |

| | Cents. |
|---|---|
| Price returned per quart for skim-milk fed, | 1.23 |
| Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound, | 1.05 |

### CALF 2.

Age when received: three days.

Breed: grade Jersey, heifer.

Grain consumed dry.

Foods fed: equal parts of skim and whole milk for two weeks (for one week only whole milk, on account of scours), later skim-milk with corn meal, and afterwards equal parts of Buffalo gluten feed and old-process linseed meal *ad libitum*.

### CALF 2 — Concluded.

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of calf, | $1 00 | – |
| 8.10 pounds corn meal, at $23 per ton, | 0 09 | – |
| 8.44 pounds gluten feed, at $20 per ton, | 0 08 | – |
| 8.44 pounds old-process linseed meal, at $26 per ton, | 0 11 | – |
| 83.50 quarts whole milk, at 3 cents, | 2 50 | – |
| 177.50 pounds live weight, at 4½ cents, | – | $7 89 |
| 555.50 quarts skim-milk returned, | 4 11 | – |
| | $7 89 | $7 89 |

| | Cents. |
|---|---|
| Price returned per quart for skim-milk fed, | 0.74 |
| Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound, | 0.60 |

### CALF 3.

Age when received: two days.

Breed: grade Ayrshire, heifer.

Grain fed dry.

Foods fed: equal parts of whole milk and skim-milk for the first two weeks (for one week whole milk only, on account of scours), and later skim-milk with equal parts of Buffalo gluten feed and old-process linseed meal.

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of calf, | $1 00 | – |
| 16.10 pounds gluten feed, at $20 per ton, | 0 16 | – |
| 16.10 pounds old-process linseed meal, at $26 per ton, | 0 20 | – |
| 77.00 quarts whole milk, at 3 cents, | 2 31 | – |
| 160.25 pounds live weight, at 4½ cents, | – | $7 21 |
| 799.00 quarts skim-milk returned, | 3 54 | – |
| | $7 21 | $7 21 |

| | Cents. |
|---|---|
| Price returned per quart for skim-milk fed, | 0.44 |
| Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound, | 0.34 |

### CALF 4.

Age when received: two days.

Breed: grade Durham, heifer.

Grain consumed dry.

Foods fed: equal parts of fresh and skim milk during first nine days, then skim-milk and wheat flour, followed for a few days by skim-milk and equal parts of wheat flour and old-process linseed meal, and finally skim-milk and equal parts of Buffalo gluten feed and wheat middlings.

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of calf, | $1 00 | – |
| 6.56 pounds wheat flour, at 2 cents, | 0 13 | – |
| 1.90 pounds old-process linseed meal, at $26 per ton, | 0 03 | – |
| 13.31 pounds gluten feed, at $20 per ton, | 0 13 | – |
| 12.44 pounds wheat middlings, at $22 per ton, | 0 14 | – |
| 32.00 quarts fresh milk, at 3 cents, | 0 96 | – |
| 185.00 pounds live weight, at 4½ cents, | – | $8 32 |
| 873.00 quarts skim-milk returned, | 5 93 | – |
| | $8 32 | $8 32 |

| | Cents. |
|---|---|
| Price returned per quart for skim-milk fed, | 0.68 |
| Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound, | 0.57 |

### CALF 5.

Age when received: three days.

Breed: grade unknown, heifer.

Foods fed: equal parts of fresh and skim milk for the first week, and after that (excepting skim-milk and a small amount of equal parts of Buffalo gluten feed and wheat middlings) skim-milk entirely.

### CALF 5 — *Concluded.*

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of calf, | $1 00 | – |
| 2.40 pounds wheat middlings, at $22 per ton, | 0 03 | – |
| 2.40 pounds gluten feed, at $20 per ton, | 0 02 | – |
| 27.00 quarts fresh milk, at 3 cents, | 0 81 | – |
| 189.25 pounds live weight, at 4½ cents, | – | $8 51 |
| 936.50 quarts skim-milk returned, | 6 65 | – |
| | $8 51 | $8 51 |

| | Cents. |
|---|---|
| Price returned per quart for skim-milk fed, | 0.71 |
| Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound, | 0.61 |

### CALF 6.

Age when received: three days.

Breed: grade Holstein, heifer.

Foods fed: for first nine days equal parts of whole and skim milk and then skim-milk only.

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of calf, | $1 25 | – |
| 40.00 quarts fresh milk, at 3 cents, | 1 20 | – |
| 166.50 pounds live weight, at 4 cents, | – | $6 66 |
| 617.00 quarts skim-milk returned, | 4 21 | – |
| | $6 66 | $6 66 |

| | Cents. |
|---|---|
| Price returned per quart for skim-milk fed, | 0.68 |
| Price returned per quart for skim-milk fed, when live weight brings 4½ cents per pound, | 0.82 |

### CALF 7.

Age when received: three days.

Breed: grade Shorthorn, heifer.

Foods fed: for first nine days equal parts of whole and skim milk, afterwards skim-milk exclusively, excepting twenty-five ounces of cod liver oil in addition to milk during nineteen days.

*Financial Statement.*

| | Debit. | Credit. |
|---|---|---|
| Original cost of calf, | $1 00 | – |
| 25.00 ounces cod liver oil, at 2.4 cents, | 0 60 | – |
| 34.00 quarts whole milk, at 3 cents, | 1 02 | – |
| 157.25 pounds live weight, at 4 cents, | – | $6 28 |
| 621.00 quarts skim-milk returned, | 3 66 | – |
| | $6 28 | $6 28 |

| | Cents. |
|---|---|
| Price returned per quart for skim-milk fed, | 0.59 |
| Price returned per quart for skim-milk fed, when live weight brings 4½ cents per pound, | 0.72 |

### SUMMARY OF ABOVE RESULTS.

1. Price returned per quart for skim-milk, when live weight sells at 4½ cents per pound: —

| | Cents. |
|---|---|
| Calves 1, 2, 3 and 4 (grain and skim-milk), | 0.77 |
| Calves 5, 6 and 7 (skim-milk alone), | 0.75 |
| Average of seven calves, | 0.76 |

2. Price returned per quart for skim-milk, when live weight sells at 4 cents per pound: —

| | Cents. |
|---|---|
| Calves 1, 2, 3 and 4 (grain and skim-milk), | 0.64 |
| Calves 5, 6 and 7 (skim-milk alone), | 0.63 |
| Average of seven calves, | 0.63 |

### ADDITIONAL INTERESTING FACTS (*Average of Seven Calves*).

| | |
|---|---|
| Average daily gain in live weight, | 1.49 pounds. |
| Dry matter required to produce 1 pound live weight, | 1.77 pounds. |
| Dry matter required to produce 1 pound dressed weight, | 2.98 pounds. |
| Shrinkage in dressing, | 44.22 per cent. |
| Average number of weeks fed, | 10 |

### PRICE OBTAINED FOR SKIM-MILK PER QUART WHEN FED TO PIGS.

Below are the average results obtained from experiments with forty pigs, being six distinct lots, fed during the years 1890–91 and 1892–93. In this number grade Chester Whites predominated, but several Yorkshires, Berkshires, Poland Chinas and Tamworths are also included. During this time the grains fed had the following average cost per ton: —

| | |
|---|---|
| Corn meal, | $24 50 |
| Wheat bran, | 22 30 |
| Buffalo gluten feed, | 24 40 |
| Chicago gluten meal, | 25 00 |

The system of pig feeding developed at the station is generally known. Those not familiar with the experiments will find the methods described in this report at the end of the feeding experiments with pigs under the heading "Practical rations for pig feeding."

To obtain the returns per quart for skim-milk, the original cost of the pig plus the cost of the grains fed are deducted from the value obtained for the dressed weight. The difference represents the value of the skim-milk. See also the same method in the calf experiment.

*Statement.*

[Cents.]

| Dressed Pork sold at — | 5½ Cents. | 6 Cents. | 6½ Cents. | 7 Cents. | 7½ Cents. | 8 Cents. |
|---|---|---|---|---|---|---|
| Price returned per quart for skim-milk fed, | 0.21 | 0.30 | 0.46 | 0.58 | 0.70 | 0.81 |

## COMMENTS ON THE RESULTS.

The experiments have shown that calves grown upon skim-milk alone or upon skim-milk and grains during the first eight weeks of their lives make good gains in live weight, namely, from 0.9 to 2.13 pounds per day, with an average of 1.49 pounds. These animals, however, put on very little fat, either when fed on skim-milk alone or when fed on skim-milk and grains. They were not able to digest the necessary amount of corn meal, Buffalo gluten feed, or wheat flour or middlings, when fed in connection with the nitrogenous milk, to promote the formation of fat.

The meat of the animals thus described was quite white in appearance, but not as tender as calves that were fed whole milk. The ribs and flanks of animals thus fed were thinner than those consuming whole milk, and the shrinkage in dressing is from 5 to 7 per cent. more.

Butchers offered from 4 to 4½ cents per pound of live weight, whole-milk veal being worth at the time 5½ to 6 cents per pound. It is to be remarked, however, that at retail as much per pound was charged for the skim-milk as for the whole-milk veal. It will be noticed that when skim-milk veal, so called, brought 4 cents per pound of live weight, an average of 0.63 of a cent per quart or 2.52 cents per gallon was obtained for the skim-milk fed; while when live weight brought 4½ cents per pound the return for the skim-milk was 0.76 of a cent per quart, or 3 cents per gallon. When the skim-milk was fed to pigs, and dressed pork brought 5½ cents per pound, there was a return of 0.2 of a cent per quart for the milk; and when dressed pork brought 7 cents per pound, 0.6 of a cent was obtained per quart for the milk, and 0.7 of a cent was obtained when dressed pork brought 7½ cents per pound.

These results are interesting and instructive, and worthy of the careful consideration of dairy farmers. It must be admitted that calves require rather more attention than pigs. The milk must not be sour and must be fed warm, and their condition must be carefully watched lest they be attacked with scours. A small quantity of lime water added to the milk at each feeding seems to act as a preventive.

No beneficial results were noticed when cod liver oil was fed in small quantities to calf 7. Its smell and taste were obnoxious to the calf, and quite often he refused the milk containing it.

The experiment indicates that, in order to secure the greatest profit, it is not wise as a rule to feed calves as above described after they have reached 160 pounds of live weight. The daily gain decreases and the food consumption steadily increases, so that the commercial value of a pound of live weight is about balanced by the cost of the food consumed to produce it.

This experiment is presented as the beginning of a series designed for the purpose of studying the most economical way in which to feed skim-milk to growing calves, especially to calves intended for veal. Whole milk forms a complete food for calves, and by its use they can be sold from five to seven weeks from birth in a fat condition. How to secure a food equal in its effect to whole milk by utilizing the skim-milk and substituting a cheaper fattening material in place of the cream removed, is the problem for future solution.

### TABLES SHOWING AVERAGE DAILY FOOD CONSUMPTION AND GAIN IN LIVE WEIGHT.

CALF 1.

| WEEKLY PERIODS (DATES). | Weight of Animal (Pounds) | Average Daily Amount of Grain consumed (Ounces). | AVERAGE DAILY AMOUNT OF MILK CONSUMED | |
|---|---|---|---|---|
| | | | Fresh Milk (Quarts). | Skim-milk (Quarts). |
| April 4-7, . . . | – | – | 3.33 | 4.70 |
| 14, . . . | 99.50 | 7.14 | – | 8.86 |
| 21, . . . | 117.25 | 10.00 | – | 10.00 |
| 28, . . . | 132.25 | 12.86 | – | 10.00 |
| May 4, . . . | 160.25 | 16.71 | – | 11.43 |
| 11, . . . | 167.75 | 20.00 | – | 9.71 |
| 18, . . . | 180.25 | 28.57 | – | 8.00 |
| 25, . . . | 177.00 | 21.14 | – | 7.57 |
| 27, . . . | 177.00 | 28.00 | – | 8.00 |
| Total gain in 54 days, | 77.50 | 18.05 | – | 8.70 |
| Average daily gain, . | 1.43 | – | – | – |

### Calf 2.

| Weekly Periods (Dates). | Weight of Animal (Pounds). | Average Daily Amount of Grain consumed (Ounces). | Average Daily Amount of Milk consumed. | |
|---|---|---|---|---|
| | | | Fresh Milk (Quarts). | Skim-milk (Quarts). |
| April 18, . . . | 74.00 | – | – | – |
| 24, . . . | 77.25 | – | 1.64 | 3.21 |
| May 4,* . . . | 88.00 | – | 5.40 | 0.05 |
| 11, . . . | 105.75 | – | 2.57 | 7.14 |
| 18, . . . | 117.75 | – | – | 12.00 |
| 25, . . . | 125.75 | 3.57 | – | 11.14 |
| June 1, . . . | 137.50 | 12.14 | – | 10.00 |
| 8, . . . | 152.00 | 8.72 | – | 9.57 |
| 15, . . . | 163.75 | 9.58 | – | 10.00 |
| 22, . . . | 173.25 | 10.86 | – | 10.00 |
| 26, . . . | 175.50 | 16.50 | – | 9.50 |
| Total gain in 70 days, | 101.50 | 10.23 | – | 8.26 |
| Average daily gain, . | 1.45 | – | – | – |

* Ten-day period.

### Calf 3.

| | | | | |
|---|---|---|---|---|
| April 21, . . . . | 53.25 | – | – | – |
| May 4,* . . . | 59.00 | – | 3.53 | 1.13 |
| 11, . . . . | 73.25 | – | 3.43 | 5.30 |
| 18, . . . . | 84.25 | – | – | 11.00 |
| 25, . . . . | 92.25 | – | – | 11.43 |
| June 1, . . . . | 99.25 | – | – | 12.00 |
| 8, . . . . | 109.50 | 7.58 | – | 10.71 |
| 15, . . . . | 118.25 | 7.14 | – | 10.00 |
| 22, . . . . | 125.25 | 6.86 | – | 10.00 |
| 29, . . . . | 137.25 | 10.86 | – | 9.71 |
| July 6, . . . . | 148.00 | 12.00 | – | 10.00 |
| 13, . . . . | 155.50 | 15.72 | – | 10.00 |
| 21, . . . . | 160.25 | 13.00 | – | 11.75 |
| Total gain in 92 days, | 107.00 | 10.45 | – | 8.78 |
| Average daily gain, . | 1.16 | – | – | – |

* Fifteen-day period.

### CALF 4.

| WEEKLY PERIODS (DATES). | Weight of Animal (Pounds). | Average Daily Amount of Grain consumed (Ounces). | AVERAGE DAILY AMOUNT OF MILK CONSUMED. | |
|---|---|---|---|---|
| | | | Fresh Milk (Quarts). | Skim-milk (Quarts). |
| June 10, . . . . | 70.75 | – | – | – |
| 16, . . . . | 78.75 | – | 3.14 | 3.14 |
| 23, . . . . | 88.25 | – | 1.43 | 8.00 |
| 30, . . . . | 101.25 | – | – | 10.57 |
| July 7, . . . . | 118.75 | – | – | 9.00 |
| 14, . . . . | 127.00 | 7.43 | – | 9.71 |
| 21, . . . . | 142.00 | 8.14 | – | 10.00 |
| 28, . . . . | 152.00 | 8.57 | – | 10.00 |
| Aug. 4, . . . . | 154.50 | 7.43 | – | 11.14 |
| 11, . . . . | 163.25 | 8.57 | – | 12.00 |
| 18, . . . . | 175.00 | 10.00 | – | 12.00 |
| 25, . . . . | 180.75 | 11.14 | – | 12.00 |
| Sept. 4, . . . . | 185.00 | 12.60 | – | 12.00 |
| Total gain in 87 days, | 114.25 | 9.23 | – | 9.96 |
| Average daily gain, . | 1.31 | – | – | – |

### CALF 5.

| | | | | |
|---|---|---|---|---|
| July 22, . . . . | 70.00 | – | – | – |
| 28, . . . . | 83.50 | – | 4.74 | 4.14 |
| Aug. 4, . . . . | 96.00 | – | – | 10.86 |
| 11, . . . . | 108.75 | – | – | 12.00 |
| 18, . . . . | 112.50 | – | – | 10.71 |
| 25, . . . . | 122.75 | 3.14 | – | 9.30 |
| Sept. 1, . . . . | 128.25 | 7.71 | – | 10.50 |
| 8, . . . . | 141.50 | – | – | 12.86 |
| 15, . . . . | 157.25 | – | – | 17.71 |
| 22, . . . . | 178.50 | – | – | 20.00 |
| Oct. 1, . . . . | 189.25 | – | – | 20.00 |
| Total gain in 72 days, | 119.25 | – | – | 12.81 |
| Average daily gain, . | 1.63 | – | – | – |

### Calf 6.

| Weekly Periods (Dates). | Weight of Animal (Pounds). | Average Daily Amount of Grain consumed (Ounces). | Average Daily Amount of Milk consumed. | |
|---|---|---|---|---|
| | | | Fresh Milk (Quarts). | Skim-milk (Quarts). |
| Sept. 29, . . . . | 68.00 | – | – | – |
| Oct. 5, . . . . | 83.75 | – | 3.71 | 3.71 |
| 12, . . . . | 95.25 | – | 2.00 | 8.00 |
| 19, . . . . | 110.50 | – | – | 11.29 |
| 26, . . . . | 126.50 | – | – | 13.71 |
| Nov. 2, . . . . | 137.00 | – | – | 13.71 |
| 9, . . . . | 152.50 | – | – | 14.86 |
| 19, . . . . | 169.50 | – | – | 16.00 |
| Total gain in 52 days, | 101.50 | – | – | 11.61 |
| Average daily gain, . | 1.95 | – | – | – |

### Calf 7.

| | | | | |
|---|---|---|---|---|
| Oct. 1, . . . . | 74.25 | – | – | – |
| 7, . . . . | 83.75 | – | 4.00 | 4.57 |
| 14, . . . . | 95.75 | – | 0.86 | 9.43 |
| 21, . . . . | 108.50 | – | – | 11.71 |
| 28, . . . . | 120.50 | – | – | 13.14 |
| Nov. 4, . . . . | 126.50 | – | – | 11.68 |
| 11, . . . . | 141.50 | – | – | 12.29 |
| 18, . . . . | 155.50 | – | – | 14.00 |
| 24, . . . . | 157.25 | – | – | 13.67 |
| Total gain in 55 days, | 83.00 | – | – | 11.31 |
| Average daily gain, . | 1.51 | – | – | – |

## TABLES GIVING DETAILED RECORD OF EACH CALF.

### CALF 1.

| Feeding Periods. | DATE OF PERIODS. | Whole Milk (Quarts). | Skim-milk (Quarts). | Corn Meal (Ounces). | Approximate Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Average Daily Gain (Pounds). | Cost of Feed per Pound of Live Weight Gained (Cents). |
|---|---|---|---|---|---|---|---|---|---|
| I. | April 4 to April 21, | 10.00 | 156.00 | 120.00 | 1:2.5 to 1:3.5 | 99.50 | 132.25 | 1.82 | 3.32 |
| II. | April 22 to May 5, | - | 150.00 | 227.00 | | 132.25 | 160.25 | 2.00 | 3.00 |
| III. | May 6 to May 27, | - | 183.00 | 536.00 | | 160.25 | 177.00 | 0.76 | 7.22 |

*Total Amount of Feed consumed from April 4 to May 27, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. |
|---|---|---|---|
| 10.00 quarts whole milk, . . . . | 2.97 | $0 30 | $0 02 |
| 489.00 quarts skim-milk, . . . . | 100.72 | 2 20 | 0 81 |
| 55.20 pounds corn meal, . . . . | 43.80 | 0 63 | 0 10 |
| | 147.49 | $3 13 | $0 93 |

| | |
|---|---|
| Live weight of the animal at the beginning of the experiment, | 99.50 lbs. |
| Live weight of the animal at the end of the experiment, . | 177.00 " |
| Live weight gained during the experiment, . . . . . | 77.50 " |
| Dressed weight of the animal, . . . . . . . | 100.00 " |
| Loss in weight by dressing, 43.50 per cent., . . . . | 77.00 " |
| Pounds of dry matter to produce 1 pound of live weight, . | 1.93 " |
| Pounds of dry matter to produce 1 pound of dressed weight, | 3.37 " |
| Total cost of feed per pound of live weight gained, . . | 4.04 cts. |
| Net cost of feed per pound of live weight gained, . . | 3.00 " |

CALF 2.

| Feeding Periods. | DATE OF PERIODS. | Whole Milk (Quarts). | Skim-milk (Quarts). | Corn Meal (Ounces). | Gluten Feed (Ounces). | Old-process Linseed Meal (Ounces). | Approximate Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Average Daily Gain (Pounds). | Cost of Feed per Pound of Live Weight Gained (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | Apr. 18 to May 12, | 83.50 | 90.50 | - | - | - | 1:2.00 to 1:3.00 | 74.00 | 105.75 | 1.27 | 9.17 |
| II. | May 13 to June 2, | - | 230.00 | 130.00 | - | - | | 105.75 | 137.50 | 1.51 | 3.55 |
| III. | June 3 to June 16, | - | 137.00 | - | 69.00 | 69.00 | | 137.50 | 163.75 | 1.87 | 2.73 |
| IV. | June 17 to June 26, | - | 98.00 | - | 66.00 | 66.00 | | 163.75 | 175.50 | 1.17 | 4.56 |

*Total Amount of Feed consumed from April 18 to June 26, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. |
|---|---|---|---|
| 83.50 quarts whole milk, . . . | 24.81 | $2 51 | $0 15 |
| 555.50 quarts skim-milk, . . . . | 116.01 | 2 50 | 0 93 |
| 8.10 pounds corn meal, . . . | 6.94 | 0 09 | 0 02 |
| 8.44 pounds Buffalo gluten feed, . . | 7.65 | 0 08 | 0 04 |
| 8.44 pounds old-process linseed meal, . | 7.49 | 0 11 | 0 06 |
| | 162.90 | $5 29 | $1 20 |

| | |
|---|---|
| Live weight of the animal at the beginning of the experiment, | 74.00 lbs. |
| Live weight of the animal at the end of the experiment, . | 175.50 " |
| Live weight gained during the experiment, . . . . . | 101.50 " |
| Dressed weight of the animal, . . . . . . . | 92.00 " |
| Loss in weight by dressing, 48 per cent., . . . . . | 83.50 " |
| Pounds of dry matter to produce 1 pound of live weight, . | 1.60 " |
| Pounds of dry matter to produce 1 pound of dressed weight, | 3.04 " |
| Total cost of feed per pound of live weight gained, . . | 5.21 cts. |
| Net cost of feed per pound of live weight gained, . . | 4.02 " |

### CALF 3.

| Feeding Periods. | DATE OF PERIODS. | Whole Milk (Quarts). | Skim-milk (Quarts). | Corn Meal (Ounces). | Gluten Feed (Ounces). | Old-process Linseed Meal (Ounces). | Approximate Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Average Daily Gain (Pounds). | Cost of Feed per Pound of Live Weight Gained (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | Apr. 21 to June 2, | 77.00 | 294.00 | 10.00 | - | - | 1:2.00 to 1:2.50 | 53.25 | 99.25 | 1.10 | 7.89 |
| II. | June 3 to June 30, | - | 281.00 | - | 113.50 | 113.50 | | 99.25 | 137.25 | 1.36 | 3.76 |
| III. | July 1 to July 21, | - | 224.00 | - | 144.00 | 144.00 | | 137.25 | 160.25 | 1.10 | 5.28 |

*Total Amount of Feed consumed from April 21 to July 21, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. |
|---|---|---|---|
| 77.00 quarts whole milk, | 22.88 | $2 31 | $0 14 |
| 799.00 quarts skim-milk, | 166.87 | 3 59 | 1 34 |
| 0.62 pounds corn meal, | 0.53 | 0 01 | - |
| 16.10 pounds Buffalo gluten feed, | 14.59 | 0 16 | 0 08 |
| 16.10 pounds old-process linseed meal, | 14.30 | 0 21 | 0 12 |
| | 219.17 | $6 28 | $1 67 |

| | |
|---|---|
| Live weight of the animal at the beginning of the experiment, | 53.25 lbs. |
| Live weight of the animal at the end of the experiment, | 160.25 " |
| Live weight gained during the experiment, | 107.00 " |
| Dressed weight of the animal, | - |
| Loss in weight by dressing, | - |
| Pounds of dry matter to produce 1 pound of live weight, | 2.03 " |
| Pounds of dry matter to produce 1 pound of dressed weight, | - |
| Total cost of feed per pound of live weight gained, | 5.87 cts. |
| Net cost of feed per pound of live weight gained, | 4.30 " |

### CALF 4.

| Feeding Periods. | DATE OF PERIODS. | Whole Milk (Quarts). | Skim-milk (Quarts). | Wheat Flour (Ounces). | Old-process Linseed Meal (Ounces). | Gluten Feed (Ounces). | Wheat Middlings (Ounces). | Approximate Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Average Daily Gain (Pounds). | Cost of Feed per Pound of Live Weight Gained (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | June 10 to June 30, | 32.00 | 152.00 | - | - | - | - | 1:2.00 to 1:2.5 | 70.75 | 101.75 | 1.48 | 5.30 |
| II. | July 1 to July 14, | - | 131.00 | 44.00 | - | - | - | | 101.75 | 127.00 | 1.80 | 2.51 |
| III. | July 15 to Aug. 11, | - | 302.00 | 61.00 | 30.00 | 76.00 | 62.00 | | 127.00 | 163.25 | 2.13 | 4.37 |
| IV. | Aug. 12 to Sept. 4, | - | 288.00 | - | - | 137.00 | 137.00 | | 163.25 | 185.00 | 0.90 | 7.14 |

*Total Amount of Feed consumed from June 10 to Sept. 4, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. |
|---|---|---|---|
| 32.00 quarts whole milk, . . . | 9.49 | $0 96 | $0 08 |
| 873.00 quarts skim-milk, . . . . | 180.18 | 3 85 | 1 43 |
| 6.56 pounds wheat flour, . . . | 5.73 | 0 13 | 0 02 |
| 1.90 pounds old-process linseed meal, . | 1.69 | 0 02 | 0 01 |
| 13.31 pounds Buffalo gluten feed, . . | 12.06 | 0 13 | 0 06 |
| 12.44 pounds wheat middlings, . . | 11.06 | 0 13 | 0 05 |
| | 220.21 | $5 22 | $1 65 |

| | |
|---|---|
| Live weight of the animal at the beginning of the experiment, | 70.75 lbs. |
| Live weight of the animal at the end of the experiment, . | 185.00 " |
| Live weight gained during the experiment, . . . . . | 114.25 " |
| Dressed weight of the animal, . . . . . . . | 101.00 " |
| Loss in weight by dressing, 45 per cent., . . . . . | 84.00 " |
| Pounds of dry matter to produce 1 pound of live weight, . | 1.93 " |
| Pounds of dry matter to produce 1 pound of dressed weight, | 3.51 " |
| Total cost of feed per pound of live weight gained, . . | 4.57 cts. |
| Net cost of feed per pound of live weight gained, . . | 3.12 " |

## CALF 5.

| Feeding Periods. | DATE OF PERIODS. | Whole Milk (Quarts). | Skim-milk (Quarts). | Gluten Feed (Ounces). | Wheat Middlings (Ounces). | Approximate Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Average Daily Gain (Pounds). | Cost of Feed per Pound of Live Weight Gained (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|
| I. | July 22 to Aug. 4. | 27.00 | 105.00 | – | – | 1:2.00 | 70.00 | 96.00 | 1.86 | 4.83 |
| II. | Aug. 5 to Sept. 1, | – | 297.50 | 38.00 | 38.00 | | 96.00 | 128.25 | 1.12 | 4.34 |
| III. | Sept. 2 to Sept. 15, | – | 214.00 | – | – | | 128.25 | 157.25 | 2.09 | 3.32 |
| IV. | Sept.16 to Oct. 1, | – | 320.00 | – | – | | 157.25 | 189.25 | 2.00 | 4.50 |

*Total Amount of Feed consumed from July 22 to Oct. 1, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. |
|---|---|---|---|
| 27.00 quarts whole milk, . . . | 8.02 | $0 81 | $0 05 |
| 936.50 quarts skim-milk, . . . . | 195.58 | 4 21 | 1 57 |
| 2.40 pounds Buffalo gluten feed, . . | 2.18 | 0 02 | 0 01 |
| 2.40 pounds wheat middlings, . . | 2.13 | 0 03 | 0 01 |
| | 207.91 | $5 07 | $1 64 |

| | |
|---|---|
| Live weight of the animal at the beginning of the experiment, | 70.00 lbs. |
| Live weight of the animal at the end of the experiment, . | 189.25 " |
| Live weight gained during the experiment, . . . . . | 119.25 " |
| Dressed weight of the animal, . . . . . . . | 108.00 " |
| Loss in weight by dressing, 43 per cent., . . . . . | 81.25 " |
| Pounds of dry matter to produce 1 pound of live weight, . | 1.74 " |
| Pounds of dry matter to produce 1 pound of dressed weight, | 2.67 " |
| Total cost of feed per pound of live weight gained, . . | 4.25 cts. |
| Net cost of feed per pound of live weight gained, . . | 3.72 " |

### CALF 6.

| Feeding Periods. | DATE OF PERIODS. | Whole Milk (Quarts). | Skim-milk (Quarts). | Approximate Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Average Daily Gain (Pounds). | Cost of Feed per Pound of Live Weight Gained (Cents). |
|---|---|---|---|---|---|---|---|---|
| I. | Sept. 29 to Oct. 13, . | 40.00 | 92.00 | 1:2.00 to 1:2.25 | 68.00 | 95.25 | 1.82 | 5.92 |
| II. | Oct. 14 to Oct. 27, . | - | 179.00 | | 95.25 | 125.50 | 1.68 | 2.66 |
| III. | Oct. 28 to Nov. 19, . | - | 346.00 | | 125.50 | 166.50 | 1.78 | 3.79 |

*Total Amount of Feed consumed from Sept. 29 to Nov. 19, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. |
|---|---|---|---|
| 40.00 quarts whole milk, . . . . | 11.89 | $1 20 | $0 07 |
| 617.00 quarts skim-milk, . . . . | 128.86 | 2 77 | 1 04 |
| | 140.74 | $3 97 | $1 11 |

| | |
|---|---|
| Live weight of the animal at the beginning of the experiment, | 68.00 lbs |
| Live weight of the animal at the end of the experiment, . | 166.50 " |
| Live weight gained during the experiment, . . . . . | 98.50 " |
| Dressed weight of the animal, . . . . . . . | 90.00 " |
| Loss in weight by dressing, 45 per cent., . . . . . | 46.50 " |
| Pounds of dry matter to produce 1 pound of live weight, . | 1.43 " |
| Pounds of dry matter to produce 1 pound of dressed weight, | 2.37 " |
| Total cost of feed per pound of live weight gained, . . | 4.03 cts. |
| Net cost of feed per pound of live weight gained, . . | 2.90 " |

### CALF 7.

| Feeding Periods. | DATE OF PERIODS. | Whole Milk (Quarts). | Skim-milk (Quarts). | Cod Liver Oil (Ounces). | Approximate Nutritive Ratio. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Average Daily Gain. (Pounds). | Cost of Feed per Pound of Live Weight Gained (Cents). |
|---|---|---|---|---|---|---|---|---|---|
| I. | Oct. 1 to Oct. 13, . | 34.00 | 86.00 | – | 1:2.00 | 74.25 | 95.75 | 1.65 | 6.62 |
| II. | Oct. 14 to Oct. 27, . | – | 174.00 | 25.00 | | 95.75 | 120.50 | 1.77 | 5.59 |
| III. | Oct. 28 to Nov. 24, . | – | 361.00 | – | | 120.50 | 157.25 | 1.31 | 4.39 |

*Total Amount of Feed consumed from Oct. 1 to Nov. 24, 1893.*

| | Dry Matter (Pounds). | Total Cost. | Manurial Value Obtainable. |
|---|---|---|---|
| 34.00 quarts whole milk, . . . | 10.24 | $1 02 | $0 06 |
| 621.00 quarts skim-milk, . . . | 129.69 | 2 79 | 1 04 |
| 25.00 ounces cod liver oil, . . . | 1.56 | 0 60 | – |
| | 141.49 | $4 41 | $1 10 |

| | |
|---|---|
| Live weight of the animal at the beginning of the experiment, | 74.25 lbs. |
| Live weight of the animal at the end of the experiment, . | 157.25 " |
| Live weight gained during the experiment, . . . . . | 83.00 " |
| Dressed weight of the animal, . . . . . . . | 91.00 " |
| Loss in weight by dressing, 42 per cent., . . . . | 66.25 " |
| Pounds of dry matter to produce 1 pound of live weight, . | 1.70 " |
| Pounds of dry matter to produce 1 pound of dressed weight, | 2.94 " |
| Total cost of feed per pound of live weight gained, . . | 5.31 cts. |
| Net cost of feed per pound of live weight gained, . . | 3.99 " |

*Local Market Cost per Ton of the Various Articles of Fodder used.*

| | |
|---|---|
| Corn meal, . . . . . . . . . . . . | $23 00 |
| Buffalo gluten feed, . . . . . . . . . . | 20 00 |
| Old-process linseed meal, . . . . . . . . . | 26 00 |
| Wheat middlings, . . . . . . . . . . . | 22 00 |
| Skim-milk, per gallon, . . . . . . . . . . | 1.8 cts. |
| Whole milk, per quart, . . . . . . . . . | 3.0 cts. |
| Wheat flour, per pound, . . . . . . . . . | 2.0 cts. |
| Cod liver oil, per gallon, . . . . . . . . . | $3 00 |

## *Analyses of Fodder Articles used.*

| FODDER ANALYSES. | Corn Meal. | Buffalo Gluten Feed. | Old-process Linseed Meal. | Wheat Middlings. | Skim-milk. | Whole Milk. |
|---|---|---|---|---|---|---|
| Moisture at 100° C., | 14.24* | 9.38 | 11.21 | 11.12 | 90.42 | 86.18 |
| Dry matter, | 85.76 | 90.62 | 88.79 | 88.88 | 9.58 | 13.82 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | | |
| Crude ash, | 1.63 | 0.98 | 6.97 | 3.48 | 8.14 | 5.35 |
| " cellulose, | 1.93 | 8.06 | 8.21 | 3.97 | - | - |
| " fat, | 3.27 | 14.47 | 8.27 | 5.92 | 2.61 | 33.43 |
| " protein, | 10.26 | 25.79 | 36.75 | 20.07 | 35.23 | 25.33 |
| Non-nitrogenous extract matter, | 82.91 | 50.70 | 39.80 | 66.56 | 54.02 | 35.89 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

* Moisture, as fed to calf 1, 20.67.

## *Fertilizing Constituents.*

[Nitrogen 17½ cents, phosphoric acid 5 cents, potassium oxide 5½ cents, per pound.]

| FERTILIZER ANALYSES. | Wheat Flour. | Corn Meal. | Buffalo Gluten Feed. | Old-process Linseed Meal. | Wheat Middlings. | Skim-milk. | Whole Milk. |
|---|---|---|---|---|---|---|---|
| Moisture, | 12.60 | 14.24 | 9.38 | 11.21 | 11.12 | 90.42 | 86.18 |
| Nitrogen, | 1.90 | 1.41 | 3.73 | 5.22 | 2.84 | 0.52 | 0.56 |
| Phosphoric acid, | 0.24 | 0.70 | 0.46 | 1.78 | 1.54 | 0.18 | 0.19 |
| Potassium oxide, | 0.18 | 0.40 | 0.10 | 1.21 | 0.87 | 0.19 | 0.17 |
| Value per 2,000 pounds, | $7 09 | $6 08 | $13 63 | $21 38 | $12 44 | $2 21 | $2 34 |
| Manurial value obtainable,* | 4 96 | 4 26 | 9 54 | 14 97 | 8 71 | 1 55 | 1 64 |

* Allowing thirty per cent. of the fertilizing constituents to be retained in the system of the growing animal.

# VI.

# DIGESTION EXPERIMENTS WITH SHEEP.

By J. B. Lindsey.*

Experiments to determine the digestibility of various foods have been conducted quite extensively in Germany for the last twenty-five years, and during the past ten years many experiments of a similar nature have been carried out by various experiment stations in the United States.

## Value of Digestion Experiments.

1. A food is valuable as a source of nourishment only in so far as its various constituents can be digested and assimilated. Two kinds of hay, one early and the other late cut, might be consumed in equal quantities by an animal, yet the early cut hay, having from ten to fifteen per cent. more digestible matter, would prove the more valuable fodder.

For one to form an intelligent opinion as to the value of different fodder stuffs, the amount of digestible matter they contain must be known.

2. It has been demonstrated that, in order to keep a milch cow of one thousand pounds live weight in good condition and to enable her to give the largest quantity of milk, she needs approximately 2.5 to 3 pounds of digestible protein, .5 pound of digestible fat and 12.5 pounds of digestible carbohydrates daily.

In combining the various foods so as to furnish approximately such a ration, it is absolutely essential that one should know the various percentages of the different digestible constituents they contain.

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* It is desired to acknowledge the efficient and painstaking services rendered by Messrs. E B. Holland, C. H. Johnson, C. H. Jones and H. D. Haskins. Mr. Johnson assisted in the stable and laboratory, Messrs. Jones and Haskins in the laboratory, and Mr. Holland in the laboratory and in collating the data.

## What the Excreta of an Animal is.

The fæces are nothing more than the undigested portion of the food. It is the portion that has resisted the action of the various secretions of the stomach and digestive fluids and bacteria of the intestines, and is consequently excreted by the animal as so much worthless material. The urine is entirely distinct from the fæces. It contains the water, and the end products of the digestion of the nitrogenous portion of the food, — the urea and hippuric acid, — which have been removed from the blood by the kidneys. It also contains about one-third of the phosphoric acid and nearly all of the alkalies of the food consumed that have not been retained in the animal's system, and small quantities of other materials that it is unnecessary to consider in this connection.

## How the Digestible Matter of a Food is Determined.

First ascertain the amount and composition of the food consumed by an animal in a given length of time, also the amount and composition of the fæces or undigested portion excreted in the same time on the basis of dry matter. The difference between them will represent the amount of the various constituents of the food digested.

The percentages of the constituents digested are called the digestion coefficients.

## DESCRIPTION OF THE PRESENT EXPERIMENT.

It has been found that ruminants — cows, steers, sheep, etc. — digest very nearly equal quantities of the same foods.* Sheep being easier to work with, the experiments here reported were conducted with these animals. The animals were grade Southdown wethers. Nos. I. and II. were three-year-olds, and Nos. III. and IV. yearlings. They weighed about one hundred pounds each.

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* See exception to this in Pennsylvania Station Report, page 46, 1890. This experiment showed that sheep digested fourteen to fifteen per cent. less dry matter, cellulose and nitrogen-free extract matter, and only one-half as much protein, as did steers, in case of ensilage made from Burrell and Whitman corn.

The animals were fed a certain weighed quantity of food for fourteen days. The first seven days were regarded as a preliminary period. This preliminary time allowed the animals to become accustomed to the new feed, and to eliminate all the previous foods from the intestines. The animals were fed a so-called maintenance ration, which is a quantity of food sufficient to keep them in good health and condition, without either gaining or losing in weight. During the last seven days the fæces were carefully collected and accurately weighed, and an aliquot part — one-tenth — dried daily and preserved for analysis.

The temperature of the barn, amount of water drank and the amount and specific gravity of the urine were also carefully noted.

The food fed was weighed out in advance for the entire period, carefully sampled, moisture determinations made at once, and a sample reserved for complete analysis. The animals were weighed at the beginning and end of each quantitative period.

### METHOD EMPLOYED IN COLLECTING THE FÆCES AND URINE.

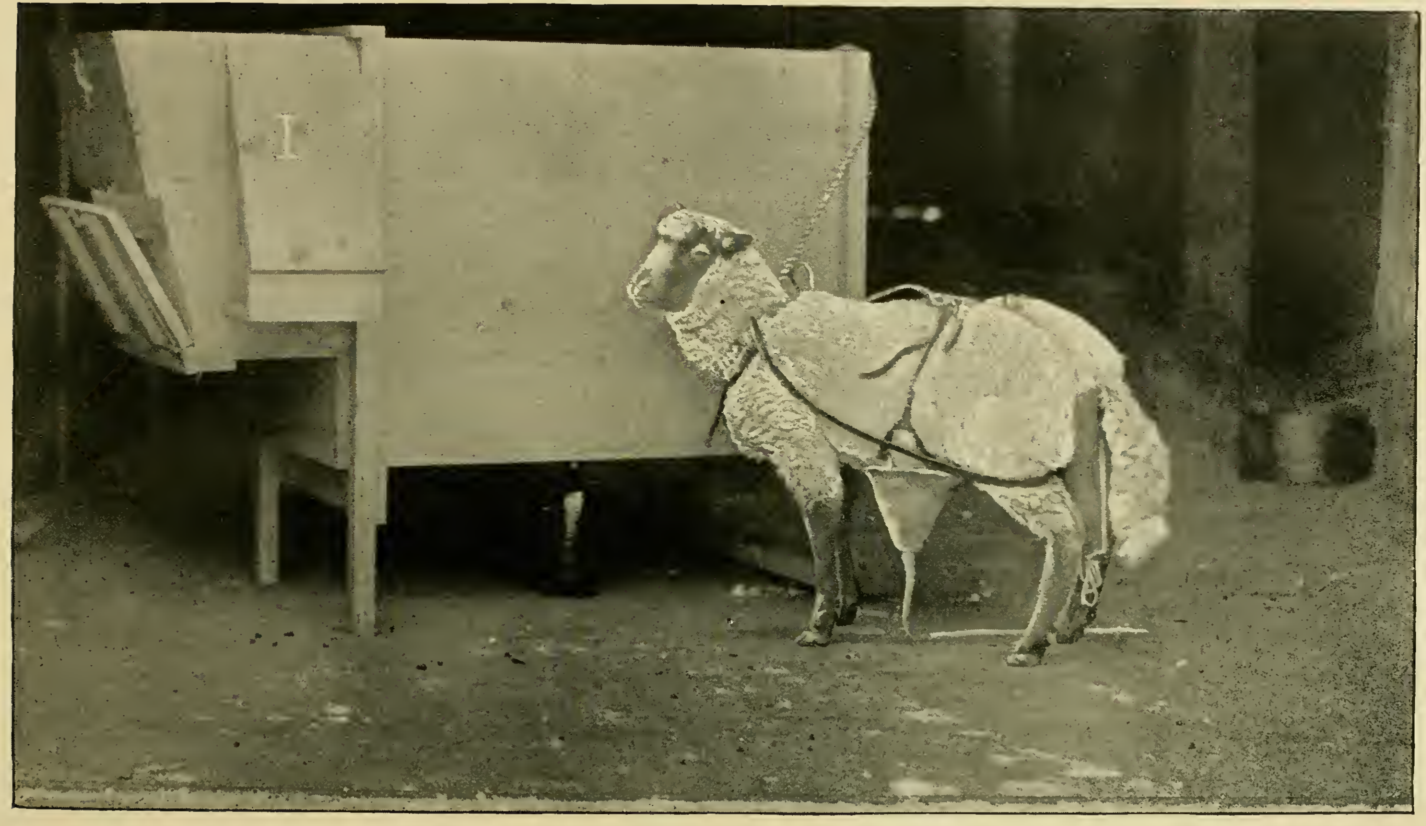
The cut presented in connection with this experiment gives a clear idea of the arrangement. The animals were confined in wooden stalls, forty-two inches long by twenty-four inches wide, raised fourteen inches above the barn floor.

By means of a light leather harness a rubber bag is securely attached behind, to collect the fæces, and a rubber funnel conducts the urine down into a bottle placed beneath the stall. The animal stands upon cushions of about one and one-half inches in thickness.

Water is before the animal at all times, contained in a galvanized-iron pan, placed on a bracket, as in figure I.

The food is given in a large zinc pan, which is made to fit tightly into the stall and can be removed at will (see just below figure 4).

The fæces were collected twice daily in large glass-stoppered bottles, and every morning one-tenth of the twenty-four hours' collection was dried and preserved.



Sheep Harnessed for Digestion Experiments at the Massachusetts State Experiment Station, 1893.

## ANALYTICAL METHODS.

At the close of the period these daily "tenths," after being weighed in an approximately air-dry condition, were mixed, and after being once run through a coarse grinding mill to break the pellets, duplicate dry matter determinations were made and the material then ground fine for a complete analysis.

Moisture determinations were made in an air bath at a temperature of 102° to 103° C., about seven grams of substance being taken. Total nitrogen was determined by the Kjeldahl method. The fat was extracted with anhydrous ether. The methods for the determination of ash and cellulose were those described by the Association of Official Agricultural Chemists.

## THE FEEDS TESTED.

The object in making these experiments has been to obtain a knowledge of the comparative digestibility of the various concentrated by-products, so called, that are being so extensively offered for sale in our Massachusetts markets. The digestibility of hay of mixed grasses grown upon the station grounds was first determined, and then a certain amount of the concentrated food was substituted for an equal amount of the hay, as the data that is to follow will show.

## BRIEF DESCRIPTION OF THE FEEDS TESTED.

### *Hay of Mixed Grasses.*

The hay is intended to be a fair average of that grown upon the station grounds. It was harvested the latter part of June, when the various grasses were in blossom. The grasses composing the same were principally herd's grass, red top, Kentucky blue-grass, meadow fescue, sweet-scented vernal grass and a fair sprinkling of clover.

### *Buffalo Gluten Feed.*

This is a by-product in the manufacture of starch from corn. The starch is separated from the yellow or albuminous part of the grain by means of water. The hulls and germs are separated by screening. After the starch is removed the yellow or flinty portion is mixed with the germs and hulls. The mixture is kiln dried and partially ground.

### *New and Old Process Linseed Meals.*

Linseed meal is that part of the seed of the flax remaining after the oil has been removed. In case of the new-process meal the fat is more thoroughly removed. Both products were in good mechanical condition, and after a few days the animals consumed them eagerly.

### *Dried Brewers' Grains.*

This is that part of the barley remaining after the starch has been largely removed by sprouting and fermentation. In order that the grains can be transported they are eventually kiln dried. The sample was in excellent condition.

### *Corn Cobs.*

These cobs were ground as fine as was practicable by our local miller. When fed they were mixed with about one-half their weight of linseed meal.

### *Spring and Winter Wheat Brans.*

These brans were in good condition, and, so far as chemical analysis indicates, had approximately the same composition.

### *Wheat Middlings.*

This was a very good quality of middlings, being ground as fine as flour. It was quite light in color.

The table of analysis of the above feeds will be found a few pages farther on.

## A SINGLE ILLUSTRATION

Showing how the digestibility of a fodder is determined. Solid manure equals the undigested part of food.

*English Hay.*

| | Dry Matter (Grams). | Crude Cellulose (Grams). | Crude Fat (Grams). | Crude Protein (Grams). | Extract Matter (Grams). |
|---|---|---|---|---|---|
| 900 grams hay fed, equal to . . . | 765.36 | 250.58 | 23.57 | 82.58 | 348.69 |
| 369.3 grams manure excreted, equal to | 337.95 | 107.00 | 12.81 | 34.64 | 145.89 |
| Amount of hay digested, . . | 427.41 | 143.58 | 10.76 | 47.94 | 202.80 |
| Per cent. digested, . . . . . | 55.84 | 57.30 | 45.65 | 58.05 | 58.16 |

A detailed account of the various digestion experiments made at this station during the past year will be found in the pages following. In the table below is presented a *résumé* of the results obtained: —

## RESULTS OF THE EXPERIMENT.

### *Digestibility of the Foods.*

| KIND OF FOOD. | Number of Different Samples. | Number of Experiments. | Number of Animals. | Dry Matter (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|---|---|---|
| Hay of mixed grasses (*a*), | 1 | 1 | 3 | 61 | 64 | 51 | 63 | 63 |
| Hay of mixed grasses (*b*), | 1 | 1 | 4 | 56 | 57 | 47 | 57 | 58 |
| Average both samples, | 2 | 2 | 7 | 58 | 60 | 49 | 60 | 60 |
| Buffalo gluten feed, | 1 | 1 | 2 | 78 | 43 | 81 | 85 | 81 |
| New-process linseed meal, | 1 | 1 | 2 | 81 | 61 | 91 | 87 | 86 |
| Old-process linseed meal, | 1 | 1 | 3 | 79 | 57 | 89 | 89 | 78 |
| Corn cobs, | 1 | 1 | 2 | 59 | 65 | 50 | 17 | 60 |
| Dried brewers' grains, | 1 | 1 | 2 | 62 | 53 | 91 | 79 | 59 |
| Spring wheat bran, | 1 | 1 | 2 | 63 | 24 | 76 | 80 | 70 |
| Winter wheat bran, | 1 | 1 | 1 | 66 | 56 | 61 | 79 | 70 |
| Wheat middlings,* | 1 | 1 | 2 | 83 | 36 | 85 | 85 | 88 |

* Very fine and quite light colored.

### Brief Remarks on the Above Results.

The Buffalo gluten feed proves to be quite digestible. The fat has approximately the same degree of digestibility as in corn meal, while the protein appears even more digestible. The cellulose and extract matter, however, fall somewhat below those of the corn meal, as would be expected.

The new and old process linseed meals compare very favorably with each other, only slight differences being observed.

Corn cobs appear fully as digestible as a good quality of English hay, with the exception of the protein, of which they contain but a small amount.

Dried brewers' grains and wheat bran approach each other very closely in the amount of dry matter digested. The digestibility of the protein in both cases appears practically identical. The fat in the brewers' grains appears rather more digestible than that in the bran, while in case of the extract matter the opposite is the result.

Winter wheat bran generally costs about two dollars per ton more in the retail markets than does the spring bran, and it was our object to see if analysis and digestibility warranted this extra price. So far as composition is concerned, the two brans are practically alike. We regret that at present positive conclusions cannot be drawn from the digestion experiments. In case of the winter wheat bran, through an unfortunate circumstance only the results obtained with one sheep can be presented. From the results offered it will be noticed that the protein and extract matter have almost identical coefficients, but the fat appears rather more digestible in the spring bran, and the cellulose more digestible in the winter bran. As these two latter ingredients are of minor importance, however, because of their comparative small absolute percentage when compared with the protein and extract matter, the comparative value of the two brans would not be seriously affected. Therefore the results thus far would indicate no material difference between the two brans. The experiment will be repeated, however, at an early date, and as soon as more decisive results are obtained they will be published.

The finer grade of wheat middlings coincides very closely in digestibility with Buffalo gluten feed. The chief difference between the two feeds is that the Buffalo gluten feed contains about four per cent. more protein than the wheat middlings.

## DETAILS OF THE EXPERIMENT.

*Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Manure Excreted.*

### SHEEP I.

| PERIODS. | Hay. | Buffalo Gluten Feed. | New-process Linseed Meal. | Old-process Linseed Meal. | Corn Cobs. | Dried Brewers' Grains. | Spring Wheat Bran. | Wheat Middlings. | Waste. | Manure. |
|---|---|---|---|---|---|---|---|---|---|---|
| III., | 85.04 | - | - | - | - | - | - | - | - | 91.51 |
| VI., | 85.34 | - | 88.10 | - | 87.95 | - | - | - | - | 92.47 |
| VII., | 86.60 | - | - | - | - | 89.68 | - | - | - | 95.34 |
| X., | 87.24 | - | - | - | - | - | - | 86.94 | - | 94.39 |

### SHEEP II.

| PERIODS. | Hay. | Buffalo Gluten Feed. | New-process Linseed Meal. | Old-process Linseed Meal. | Corn Cobs. | Dried Brewers' Grains. | Spring Wheat Bran. | Wheat Middlings. | Waste. | Manure. |
|---|---|---|---|---|---|---|---|---|---|---|
| I., | 84.24 | - | - | - | - | - | - | - | 79.33 | 92.07 |
| II., | 83.51 | 90.59 | - | - | - | - | - | - | 77.67 | 88.78 |
| III., | 85.04 | - | - | - | - | - | - | - | - | 91.56 |
| IV., | 87.73 | - | 88.28 | - | - | - | - | - | - | 94.53 |
| V., | 86.23 | - | - | 87.28 | - | - | - | - | - | 94.79 |
| VI., | 85.34 | - | 88.10 | - | 87.89 | - | - | - | - | 91.40 |
| VII., | 86.60 | - | - | - | - | 89.68 | - | - | - | 93.36 |
| VIII., | 87.24 | - | - | - | - | - | 87.31 | - | - | 95.12 |

### SHEEP III.

| PERIODS. | Hay. | Buffalo Gluten Feed. | New-process Linseed Meal. | Old-process Linseed Meal. | Spring Wheat Bran. | Winter Wheat Bran. | Wheat Middlings. | Waste. | Manure. |
|---|---|---|---|---|---|---|---|---|---|
| I., | 85.50 | - | - | - | - | - | - | 74.28 | 92.75 |
| III., | 85.04 | - | - | - | - | - | - | - | 91.33 |
| IV., | 87.73 | - | 88.28 | - | - | - | - | - | 94.10 |
| V., | 86.23 | - | - | 87.28 | - | - | - | - | 94.67 |
| VIII., | 87.24 | - | - | - | 87.31 | - | - | - | 95.04 |

### SHEEP IV.

| PERIODS. | Hay. | Buffalo Gluten Feed. | New-process Linseed Meal. | Old-process Linseed Meal. | Spring Wheat Bran. | Winter Wheat Bran. | Wheat Middlings. | Waste. | Manure. |
|---|---|---|---|---|---|---|---|---|---|
| I., | 85.50 | - | - | - | - | - | - | - | 92.60 |
| II., | 88.05 | 90.00 | - | - | - | - | - | - | 91.00 |
| III., | 85.04 | - | - | - | - | - | - | - | 90.87 |
| V., | 87.73 | - | - | 88.00 | - | - | - | - | 94.58 |
| IX., | 86.23 | - | - | - | - | 86.49 | - | - | 95.60 |
| X., | 87.24 | - | - | - | - | - | 86.94 | - | 95.13 |

## *Composition of Feed Stuffs.*

[Dry Matter.]

| | Crude Ash (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|
| Hay (*a*), | 6.58 | 30.33 | 3.48 | 11.10 | 48.51 |
| Hay (*b*), | 7.83 | 32.74 | 3.08 | 10.79 | 45.56 |
| Buffalo gluten feed, | 0.78 | 8.38 | 14.29 | 26.35 | 50.20 |
| New-process linseed meal, | 5.84 | 8.59 | 4.01 | 40.40 | 41.16 |
| Old-process linseed meal, | 6.97 | 8.21 | 8.27 | 36.75 | 39.80 |
| Corn cobs, | 1.92 | 27.17 | 1.28 | 3.86 | 65.77 |
| Dried brewers' grains, | 3.59 | 14.52 | 7.81 | 22.99 | 51.09 |
| Spring wheat bran, | 6.13 | 11.48 | 5.40 | 17.60 | 59.39 |
| Winter wheat bran, | 6.24 | 9.32 | 4.57 | 17.04 | 62.83 |
| Wheat middlings, | 1.50 | 3.53 | 6.10 | 21.06 | 67.81 |
| Waste from Sheep II.,* | 15.07 | 27.78 | 2.97 | 11.84 | 42.34 |
| Waste from Sheep II.,† | 12.85 | 28.47 | 2.93 | 11.28 | 44.48 |
| Waste from Sheep III.,* | 14.68 | 18.02 | 3.79 | 14.98 | 48.53 |

* Period I. † Period II.

## *Composition of the Fæces.*

[Dry Matter.]

### SHEEP I.

| | Crude Ash (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|
| *Period III.* | | | | | |
| Hay, | 11.13 | 31.66 | 3.79 | 10.25 | 43.17 |
| *Period VI.* | | | | | |
| Hay, new-process linseed meal and corn cob, | 8.28 | 27.53 | 2.62 | 11.37 | 50.20 |
| *Period VII.* | | | | | |
| Hay and dried brewers' grains, | 11.99 | 25.52 | 2.82 | 11.55 | 48.12 |
| *Period X.* | | | | | |
| Hay and wheat middlings, | 11.80 | 27.89 | 3.75 | 11.83 | 44.73 |

### SHEEP II.

| | | | | | |
|---|---|---|---|---|---|
| *Period I.* | | | | | |
| Hay, | 11.99 | 28.72 | 3.81 | 10.35 | 45.13 |
| *Period II.* | | | | | |
| Hay and Buffalo gluten feed, | 11.39 | 26.64 | 5.49 | 11.57 | 44.91 |

SHEEP II. — *Concluded.*

| | Crude Ash (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|
| *Period III.* | | | | | |
| Hay, | 10.33 | 32.16 | 3.62 | 10.06 | 43.83 |
| *Period IV.* | | | | | |
| Hay and new-process linseed meal, | 12.02 | 30.50 | 3.35 | 12.81 | 41.32 |
| *Period V.* | | | | | |
| Hay and old-process linseed meal, | 12.29 | 30.05 | 3.45 | 12.00 | 42.21 |
| *Period VI.* | | | | | |
| Hay, new-process linseed meal and corn cob, | 8.77 | 26.63 | 2.60 | 11.07 | 50.93 |
| *Period VII.* | | | | | |
| Hay and dried brewers' grains, | 11.30 | 26.68 | 3.02 | 10.66 | 48.34 |
| *Period VIII.* | | | | | |
| Hay and spring-wheat bran, | 11.57 | 29.65 | 3.58 | 10.16 | 45.04 |

SHEEP III.

| | Crude Ash (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|
| *Period I.* | | | | | |
| Hay, | 10.30 | 27.48 | 4.83 | 10.62 | 46.77 |
| *Period III.* | | | | | |
| Hay, | 11.28 | 31.47 | 3.65 | 10.69 | 42.91 |
| *Period IV.* | | | | | |
| Hay and new-process linseed meal, | 12.68 | 28.89 | 3.41 | 13.06 | 41.96 |
| *Period V.* | | | | | |
| Hay and old-process linseed meal, | 12.32 | 28.84 | 4.11 | 11.13 | 43.60 |
| *Period VIII.* | | | | | |
| Hay and spring-wheat bran, | 13.46 | 29.01 | 3.62 | 10.10 | 43.81 |

SHEEP IV.

| | Crude Ash (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|
| *Period I.* | | | | | |
| Hay, | 10.99 | 27.72 | 4.50 | 10.43 | 46.36 |
| *Period II.* | | | | | |
| Hay and Buffalo gluten feed, | 9.21 | 26.90 | 6 22 | 12.42 | 45.25 |
| *Period III.* | | | | | |
| Hay, | 11.50 | 31.17 | 3.68 | 10.50 | 43.15 |
| *Period V.* | | | | | |
| Hay and old-process linseed meal, | 11.92 | 28.31 | 3.80 | 12.56 | 43.41 |
| *Period IX.* | | | | | |
| Hay and winter wheat bran, | 12.80 | 25.92 | 4.15 | 10.61 | 46.52 |
| *Period X.* | | | | | |
| Hay and wheat middlings, | 12.33 | 28.88 | 4.25 | 11.54 | 43.00 |

### *Tables showing Food fed and Water drank Daily, the Daily Amount of Manure and Urine excreted and the Temperature of the Stables.*

### PERIOD I. SHEEP II.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| 1893. | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| March 31, . . | 45.0 | 900 | 90.0 | 34.30 | 1,106 | 1.0303 | 1,915 |
| April 1, . . | 43.0 | 882 | 88.2 | 34.61 | 1,102 | 1.0331 | 1,855 |
| 2, . . | 46.0 | 693 | 69.3 | 27.04 | 1,017 | 1.0337 | 1,820 |
| 3, . . | 36.0 | 869 | 86.9 | 33.69 | 977 | 1.0356 | 1,650 |
| 4, . . | 45.0 | 711 | 71.1 | 28.84 | 1,071 | 1.0342 | 1,532 |
| 5, . . | 50.0 | 776 | 77.6 | 31.54 | 1,054 | 1.0340 | 1,780 |
| 6, . . | 44.0 | 817 | 81.7 | 34.02 | 1,003 | 1.0358 | 1,480 |
| Averages, . | 44.1 | 807 | 80.7 | 32.06 | 1,047 | 1.0338 | 1,719 |

| | |
|---|---|
| Weight of animal at beginning of period, . . . . | 110.75 lbs. |
| Weight of animal at end of period, . . . . . | 110.75 " |

### PERIOD I. SHEEP III.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| 1893. | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| May 9, . . | 64.0 | 918 | 91.8 | 32.29 | 1,033 | 1.0301 | 1,753 |
| 10, . . | 69.5 | 817 | 81.7 | 31.98 | 1,073 | 1.0324 | 2,350 |
| 11, . . | 72.5 | 806 | 80.6 | 32.59 | 893 | 1.0340 | 2,645 |
| 12, . . | 72.5 | 757 | 75.7 | 30.97 | 1,108 | 1.0291 | 3,153 |
| 13, . . | 60.0 | 653 | 65.3 | 26.78 | 917 | 1.0344 | 2,725 |
| 14, . . | 64.0 | 719 | 71.9 | 29.15 | 1,104 | 1.0306 | 1,675 |
| 15, . . | 69.5 | 846 | 84.6 | 32.45 | 878 | 1.0321 | 1,978 |
| Averages, . | 67.4 | 788 | 78.8 | 30.89 | 1,009 | 1.0318 | 2,326 |

| | |
|---|---|
| Weight of animal at beginning of period, . . . . | 104.50 lbs. |
| Weight of animal at end of period, . : . . . | 105.25 " |

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* The amount of urine here reported includes the water used to wash the inside of the rubber funnel. This amounted to 194.3 grams daily.

### PERIOD I. SHEEP IV.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| May 9, . . | 64.0 | 783 | 78.3 | 30.04 | 1,319 | 1.0239 | 1,617 |
| 10, . . | 69.5 | 928 | 92.8 | 33.59 | 1,282 | 1.0266 | 2,332 |
| 11, . . | 72.5 | 852 | 85.2 | 32.74 | 1,183 | 1.0272 | 2,395 |
| 12, . . | 72.5 | 818 | 81.8 | 31.92 | 1,613 | 1.0231 | 1,438 |
| 13, . . | 60.0 | 792 | 79.2 | 32.93 | 1,343 | 1.0259 | 2,415 |
| 14, . . | 64.0 | 753 | 75.3 | 30.41 | 1,291 | 1.0262 | 1,850 |
| 15, . . | 69.5 | 803 | 80.3 | 32.72 | 1,429 | 1.0268 | 2,155 |
| Averages, . | 67.4 | 818 | 81.8 | 32.05 | 1,351 | 1.0257 | 2,027 |

| | |
|---|---|
| Weight of animal at beginning of period, . . . . | 102.25 lbs. |
| Weight of animal at end of period, . . . . . | 101.50 " |

### PERIOD II. SHEEP II.

[Fodder consumed daily: 600 grams hay, 300 grams Buffalo gluten feed and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| April 15, . . | 44.5 | 897 | 89.7 | 35.07 | 1,141 | 1.0310 | 1,950 |
| 16, . . | 49.0 | 781 | 78.1 | 31.26 | 1,004 | 1.0254 | 1,763 |
| 17, . . | 43.0 | 807 | 80.7 | 30.33 | – | – | 1,787 |
| 18, . . | 46.0 | 704 | 70.4 | 24.43 | 901 | 1.0323 | 1,905 |
| 19, . . | 46.5 | 724 | 72.4 | 27.67 | 1,180 | 1.0257 | 2,062 |
| 20, . . | 43.5 | 709 | 70.9 | 26.77 | 1,150 | 1.0270 | 1,726 |
| Averages, . | 45.4 | 770 | 77.0 | 29.26 | 1,075 | 1.0283 | 1,866 |

| | |
|---|---|
| Weight of animal at beginning of period, . . . . | 111.00 lbs. |
| Weight of animal at end of period, . . . . . | 110.75 " |

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* See foot-note on page 157.

### PERIOD II. SHEEP IV.

[Fodder consumed daily: 600 grams hay, 250 grams Buffalo gluten feed and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| June 10, . . | 79.5 | 833 | 83.3 | 26.45 | – | – | – |
| 11, . . | 82.0 | 781 | 78.1 | 26.51 | 1,309 | 1.0195 | 3,316 |
| 12, . . | 75.5 | 753 | 75.3 | 26.85 | 1,470 | 1.0125 | 3,350 |
| 13, . . | 72.5 | 629 | 62.9 | 26.79 | 1,000 | 1.0260 | 2,541 |
| 14, . . | 77.0 | 689 | 68.9 | 27.82 | – | – | 2,193 |
| 15, . . | 80.0 | 743 | 74.3 | 28.95 | 1,512 | 1.0183 | 3,154 |
| Averages, . | 77.8 | 738 | 73.8 | 27.23 | 1,323 | 1.0191 | 2,911 |

Weight of animal at beginning of period, . . . . . 102.50 lbs.
Weight of animal at end of period, . . . . . . 104.50 "

### PERIOD III. SHEEP I.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| September 25, . | 60 | 975.0 | 97.5 | 35.69 | 1,548 | 1.0190 | 2,248 |
| 26, . | 56 | 974.0 | 97.4 | 39.06 | 1,831 | – | 2,435 |
| 27, . | 50 | 867.0 | 86.7 | 35.88 | 1,451 | 1.0229 | 1,975 |
| 28, . | 58 | 861.0 | 86.1 | 36.86 | 1,716 | 1.0191 | 2,395 |
| 29, . | 52 | 823.0 | 82.3 | 35.47 | 1,816 | 1.0209 | 1,932 |
| 30, . | 57 | 869.0 | 86.9 | 37.03 | 1,982 | 1.0191 | 2,406 |
| October 1, . | 55 | 863.0 | 86.3 | 38.74 | 1,773 | 1.0180 | 2,083 |
| Averages, . | 57 | 890.3 | 89.03 | 36.96 | 1,731 | 1.0132 | 2,211 |

Weight of animal at beginning of period, . . . . . 94.00 lbs.
Weight of animal at end of period, . . . . . . . 92.75 "

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* See foot-note on page 157.

### PERIOD III. SHEEP II.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| September 19, . | 60 | 770.0 | 77.00 | 37.57 | 1,165 | 1.0304 | 1,740 |
| 20, . | 70 | 745.0 | 74.50 | 35.89 | 1,114 | 1.0295 | 1,775 |
| 21, . | 61 | 832.0 | 83.20 | 39.80 | – | – | 1,279 |
| 22, . | 58 | 867.0 | 86.70 | 30.92 | – | – | 1,525 |
| 23, . | 60 | 734.0 | 73.40 | 34.58 | 1,314 | 1.0285 | 1,510 |
| 24, . | 62 | 775.0 | 77.50 | 36.60 | 1,135 | 1.0318 | – |
| 25, . | 60 | 824.0 | 82.40 | 38.35 | 1,201 | 1.0286 | – |
| Averages, . | 62 | 792.4 | 79.24 | 37.53 | 1,186 | 1.0297 | 1,566 |

Weight of animal at beginning of period, . . . . . 98.75 lbs.
Weight of animal at end of period, . . . . . . 98.50 "

### PERIOD III. SHEEP III.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| September 19, . | 60 | 753.0 | 75.3 | 37.72 | 943 | 1.0344 | 1,077 |
| 20, . | 70 | 764.0 | 76.4 | 37.59 | 896 | 1.0342 | 1,685 |
| 21, . | 61 | 798.0 | 79.8 | 38.55 | 916 | 1.0333 | 1,875 |
| 22, . | 58 | 896.0 | 89.6 | 38.38 | 1,092 | 1.0314 | 1,687 |
| 23, . | 60 | 816.0 | 81.6 | 35.84 | 1,010 | 1.0330 | 1,603 |
| 24, . | 62 | 787.0 | 78.7 | 32.46 | 976 | 1.0329 | – |
| 25, . | 60 | 857.0 | 85.7 | 39.54 | 1,090 | 1.0335 | – |
| Averages, . | 62 | 810.1 | 81.01 | 37.15 | 989 | 1.0333 | 1,585 |

Weight of animal at beginning of period, . . . . . . 94 lbs.
Weight of animal at end of period, . . . . . . . 95 "

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* See foot-note on page 157.

### PERIOD III. SHEEP IV.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine * excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| September 19, . | 60 | 949.0 | 94.9 | 42.23 | 1,198 | 1.0291 | 1,835 |
| 20, . | 70 | 782.0 | 78.2 | 35.68 | 1,375 | 1.0262 | 1,930 |
| 21, . | 61 | 827.0 | 82.7 | 37.98 | 1,334 | – | 1,806 |
| 22, . | 58 | 759.0 | 75.9 | 35.61 | 1,328 | 1.0259 | 1,653 |
| 23, . | 60 | 722.0 | 72.2 | 34.11 | 1,321 | 1.0252 | 1,603 |
| 24, . | 62 | 794.0 | 79.4 | 38.32 | 1,248 | 1.0270 | – |
| 25, . | 60 | 745.0 | 74.5 | 36.31 | 1,555 | 1.0201 | – |
| Averages, . | 62 | 796.9 | 79.7 | 37.18 | 1,337 | 1.0256 | 1,765 |

Weight of animal at beginning of period, . . . . . 102.00 lbs.
Weight of animal at end of period, . . . . . . 102.25 "

### PERIOD IV. SHEEP II.

[Fodder consumed daily: 600 grams hay, 250 grams new-process linseed meal and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine * excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| November 6, . | 47.0 | 742 | 74.2 | 31.25 | 1,141 | 1.0330 | 1,295 |
| 7, . | 46.0 | 743 | 74.3 | 29.34 | 1,156 | 1.0337 | 1,454 |
| 8, . | 38.0 | 771 | 77.1 | 30.19 | 1,025 | 1.0359 | 1,481 |
| 9, . | 47.5 | 825 | 82.5 | 30.07 | 1,001 | 1.0354 | 1,320 |
| 10, . | 43.5 | 819 | 81.9 | 29.24 | 954 | 1.0387 | 1,254 |
| 11, . | 44.5 | 819 | 81.9 | 28.02 | 943 | 1.0379 | 1,843 |
| 12, . | 40.0 | 855 | 85.5 | 29.80 | 1,044 | 1.0364 | 1,565 |
| Averages, . | 43.8 | 796 | 79.6 | 29.70 | 1,038 | 1.0359 | 1,459 |

Weight of animal at beginning of period, . . . . . 99.25 lbs.
Weight of animal at end of period, . . . . . . 100.25 "

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* See foot-note on page 157.

### PERIOD IV. SHEEP III.

[Fodder consumed daily: 600 grams hay, 250 grams new-process linseed meal and 5 grams salt ]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine * excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| November 6, . | 47.0 | 655 | 65.5 | 29.68 | 1,108 | 1.0358 | 1,125 |
| 7, . | 46.0 | 739 | 73.9 | 31.35 | 1,079 | 1.0346 | 1,120 |
| 8, . | 38.0 | 640 | 64.0 | 28.17 | 982 | 1.0377 | 1,381 |
| 9, . | 47.5 | 644 | 64.4 | 27.93 | 1,069 | 1.0349 | 1,205 |
| 10, . | 43.5 | 676 | 67.6 | 27.88 | 1,140 | 1.0338 | 1,336 |
| 11, . | 44.5 | 653 | 65.3 | 28.12 | 1,054 | 1.0379 | 720 |
| 12, . | 40.0 | 698 | 69.8 | 29.04 | 1,001 | 1.0366 | 1,760 |
| Averages, . | 43.8 | 672 | 67.2 | 28.88 | 1,062 | 1.0359 | 1,235 |

Weight of animal at beginning of period, . . . . . 95.75 lbs.

Weight of animal at end of period, . . . . . . 96.25 "

### PERIOD V. SHEEP II.

[Fodder consumed daily: 600 grams hay, 250 grams old-process linseed meal and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine * excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| November 20, . | 41.5 | 811 | 81.1 | 30.45 | 1,072 | 1.0350 | 393 |
| 21, . | 35.0 | 716 | 71.6 | 28.00 | 839 | 1.0420 | 1,795 |
| 22, . | 45.0 | 751 | 75.1 | 30.98 | 866 | 1.0400 | 1,368 |
| 23, . | 46.0 | 746 | 74.6 | 30.60 | 955 | 1.0415 | 1,081 |
| 24, . | 38.0 | 668 | 66.8 | 28.76 | 880 | 1.0405 | 1,293 |
| 25, . | 37.0 | 656 | 65.6 | 27.97 | 956 | 1.0420 | 1,204 |
| 26, . | 37.0 | 837 | 83.7 | 34.24 | 944 | 1.0400 | 1,148 |
| Averages, . | 40.1 | 741 | 74.1 | 30.14 | 930 | 1.0401 | 1,183 |

Weight of animal at beginning of period, . . . . . 100.25 lbs.

Weight of animal at end of period, . . . . . . 99.50 "

---

* See foot-note on page 157.

### PERIOD V. SHEEP III.

[Fodder consumed daily: 600 grams hay, 250 grams old-process linseed meal and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved | Sample Air Dry. | Urine * excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| November 20, . | 41.5 | 660 | 66.0 | 29.15 | 974 | 1.0410 | 728 |
| 21, . | 35.0 | 617 | 61.7 | 27.54 | 867 | 1.0405 | 1,715 |
| 22, . | 45.0 | 637 | 63.7 | 27.57 | 951 | 1.0410 | 1,110 |
| 23, . | 46.0 | 694 | 69.4 | 30.23 | 990 | 1.0400 | 1,499 |
| 24, . | 38.0 | 543 | 54.3 | 25.88 | 1,191 | 1.0310 | 1,222 |
| 25, . | 37.0 | 647 | 64.7 | 28.68 | 987 | 1.0390 | 697 |
| 26, . | 37.0 | 682 | 68.2 | 29.18 | 1,133 | 1.0340 | 1,017 |
| Averages, . | 40.1 | 640 | 64.0 | 28.32 | 1,013 | 1.0381 | 1,141 |

Weight of animal at beginning of period, . . . . . 95.50 lbs.
Weight of animal at end of period, . . . . . . 96.50 "

### PERIOD V. SHEEP IV.

[Fodder consumed daily: 600 grams hay, 250 grams old-process linseed meal and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine * excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| November 6, . | 47.0 | 752 | 75.2 | 29.29 | 1,376 | 1.0254 | 1,954 |
| 7, . | 46.0 | 762 | 76.2 | 29.31 | 1,610 | 1.0216 | 1,731 |
| 8, . | 38.0 | 846 | 84.6 | 33.02 | 1,163 | 1.0295 | 1,113 |
| 9, . | 47.5 | 737 | 73.7 | 28.05 | 1,150 | 1.0292 | 1,427 |
| 10, . | 43.5 | 809 | 80.9 | 30.95 | 1,174 | 1.0301 | 1,390 |
| 11, . | 44.5 | 739 | 73.9 | 30.73 | 1,235 | 1.0296 | 1,450 |
| 12, . | 40.0 | 645 | 64.5 | 25.99 | 1,271 | 1.0289 | 1,825 |
| Averages, . | 43.8 | 756 | 75.6 | 29.62 | 1,283 | 1.0278 | 1,556 |

Weight of animal at beginning of period, . . . . . 102.75 lbs.
Weight of animal at end of period, . . . . . . 104.00 "

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* See foot-note on page 157.

## PERIOD VI. SHEEP I.

[Fodder consumed daily: 450 grams hay, 400 grams corn cobs, 250 grams new-process linseed meal and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| October 13, . | 61 | 942.0 | 94.2 | 36.65 | 1,332 | 1.0227 | 2,428 |
| 14, . | 68 | 956.0 | 95.6 | 38.71 | 1,074 | 1.0274 | 2,320 |
| 15, . | 58 | 1,032.0 | 103.2 | 39.12 | 1,132 | 1.0276 | 1,875 |
| 16, . | 50 | 918.0 | 91.8 | 35.57 | 971 | 1.0315 | 2,330 |
| 17, . | 54 | 1,127.0 | 112.7 | 41.68 | 967 | 1.0313 | 1,362 |
| 18, . | 56 | 1,019.0 | 101.9 | 35.87 | 1,024 | 1.0286 | 1,605 |
| 19, . | 51 | 1,142.0 | 114.2 | 39.66 | 1,045 | 1.0280 | 1,953 |
| Averages, . | 57 | 1,019.4 | 101.9 | 38.18 | 1,078 | 1.0282 | 1,982 |

Weight of animal at beginning of period, . . . . . 92.75 lbs.
Weight of animal at end of period, . . . . . . 94.75 "

## PERIOD VI. SHEEP II.

[Fodder consumed daily: 400 grams hay, 400 grams corn cobs, 200 grams new-process linseed meal and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| October 6, . | 59 | 829.0 | 82.9 | 35.33 | 726.0 | 1.0337 | 2,018 |
| 7, . | 67 | 1,004.0 | 100.4 | 39.92 | 857.0 | 1.0319 | 1,852 |
| 8, . | 61 | 946.0 | 94.6 | 33.39 | 810.0 | 1.0320 | 1,510 |
| 9, . | 65 | 999.0 | 99.9 | 35.86 | – | – | 1,765 |
| 10, . | 61 | 1,076.0 | 107.6 | 36.07 | 739.0 | 1.0357 | 1,696 |
| 11, . | 61 | 1,040.0 | 104.5 | 34.80 | 751.0 | 1.0345 | 2,080 |
| 12, . | 70 | 1,229.0 | 122.9 | 38.69 | 780.0 | 1.0374 | 1,070 |
| Averages, . | 63 | 1,018.3 | 101.8 | 36.29 | 777.1 | 1.0342 | 1,713 |

Weight of animal at beginning of period, . . . . . 95.75 lbs.
Weight of animal at end of period, . . . . . . 97.00 "

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* See foot-note on page 157.

### PERIOD VII. SHEEP I.

[Fodder consumed daily: 500 grams hay, 400 grams dried brewers' grains and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| November 24, . | 38.0 | 892 | 89.2 | 34.92 | 1,384 | 1.0180 | 2,392 |
| 25, . | 37.0 | 875 | 87.5 | 33.61 | 1,437 | 1.0190 | 1,887 |
| 26, . | 37.0 | 995 | 99.5 | 36.02 | 1,693 | 1.0170 | 1,515 |
| 27, . | 30.0 | 787 | 78.7 | 30.67 | 1,370 | 1.0210 | 2,363 |
| 28, . | 51.0 | 883 | 88.3 | 32.62 | 1,179 | 1.0205 | 963 |
| 29, . | 43.5 | 955 | 95.5 | 36.93 | 1,157 | 1.0210 | 1,846 |
| 30, . | 47.0 | 1,014 | 101.4 | 36.66 | 1,659 | 1.0160 | 2,065 |
| Averages, . | 40.5 | 914 | 91.4 | 34.49 | 1,411 | 1.0189 | 1,862 |

Weight of animal at beginning of period, . . . . . 96.00 lbs.
Weight of animal at end of period, . . . . . . 95.75 "

### PERIOD VII. SHEEP II.

[Fodder consumed daily: 500 grams hay, 400 grams dried brewers' grains and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| October 21, . | 60.0 | 908.0 | 90.8 | 35.91 | 791 | 1.0307 | 1,560 |
| 22, . | 52.0 | 939.0 | 93.9 | 38.44 | 780 | 1.0311 | 1,882 |
| 23, . | 62.0 | 856.0 | 85.6 | 35.09 | 801 | 1.0288 | 1,328 |
| 24, . | 64.0 | 825.0 | 82.5 | 35.95 | 786 | 1.0298 | 1,390 |
| 25, . | 62.0 | 911.0 | 91.1 | 38.74 | 787 | 1.0301 | 1,910 |
| 26, . | 47.0 | 897.0 | 89.7 | 35.41 | 911 | 1.0286 | 1,485 |
| 27, . | – | 1,028.0 | 102.8 | 39.29 | 835 | 1.0292 | 1,133 |
| Averages, . | 57.8 | 909.1 | 90.91 | 36.98 | 813 | 1.0298 | 1,527 |

Weight of animal at beginning of period, . . . . . 99.00 lbs.
Weight of animal at end of period, . . . . . . 100.25 "

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* See foot-note on page 157.

### Period VIII. Sheep II.

[Fodder consumed daily: 600 grams hay, 300 grams spring-wheat bran and 5 grams salt.]

| Date. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| December 5, . | 26 | 842.0 | 84.2 | 30.21 | 1,157 | 1.0280 | 1,703 |
| 6, . | 32 | 983.0 | 98.3 | 35.64 | 1,020 | 1.0310 | 897 |
| 7, . | 33 | 854.0 | 85.4 | 31.48 | 894 | 1.0360 | 1,897 |
| 8, . | 30 | 1,065.0 | 106.5 | 36.81 | 936 | 1.0295 | 1,181 |
| 9, . | 29 | 1,107.0 | 110.7 | 37.40 | 840 | 1.0360 | 1,407 |
| 10, . | 37 | 1,106.0 | 110.6 | 36.01 | 908 | 1.0340 | 1,484 |
| 11, . | 32 | 1,160.0 | 116.0 | 38.13 | 915 | - | 1,425 |
| Averages, . | 31 | 1,016.7 | 101.7 | 35.10 | 953 | 1.0324 | 1,428 |

Weight of animal at beginning of period, . . . . . 99.75 lbs.
Weight of animal at end of period, . . . . . 100.25 "

### Period VIII. Sheep III.

[Fodder consumed daily: 600 grams hay, 300 grams spring-wheat bran and 5 grams salt.]

| Date. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| December 5, . | 26.0 | 750 | 75.0 | 29.04 | 911 | 1.0345 | 1,105 |
| 6, . | 32.0 | 988 | 98.8 | 38.69 | 973 | 1.0345 | 40 |
| 7, . | 33.5 | 918 | 91.8 | 34.30 | 754 | 1.0400 | 1,597 |
| 8, . | 30.5 | 965 | 96.5 | 35.09 | 744 | 1.0345 | 1,709 |
| 9, . | 29.0 | 965 | 96.5 | 35.07 | 796 | 1.0370 | 880 |
| 10, . | 37.5 | 881 | 88.1 | 33.13 | 880 | 1.0380 | 1,318 |
| 11, . | 32.5 | 1,000 | 100.0 | 37.36 | 897 | - | 1,020 |
| Averages, . | 31.6 | 924 | 92.4 | 34.67 | 851 | 1.0364 | 1,096 |

Weight of animal at beginning of period, . . . . . 98.25 lbs.
Weight of animal at end of period, . . . . . 97.75 "

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* See foot-note on page 157.

## PERIOD IX. SHEEP IV.

[Fodder consumed daily: 600 grams hay, 300 grams winter-wheat bran and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| November 21, . | 35.0 | 982 | 98.2 | 32.87 | 1,114 | 1.0239 | 1,928 |
| 22, . | 45.0 | 924 | 92.4 | 30.76 | 1,235 | 1.0220 | 1,790 |
| 23, . | 46.0 | 1,246 | 124.6 | 41.04 | 1,194 | 1.0260 | 1,738 |
| 24, . | 38.0 | 706 | 70.6 | 25.10 | 1,081 | 1.0270 | 2,178 |
| 25, . | 37.0 | 973 | 97.3 | 33.57 | 1,182 | 1.0260 | 1,151 |
| 26, . | 37.0 | 1,258 | 125.8 | 32.91 | 1,156 | 1.0260 | 1,443 |
| 27, . | 30.0 | 1,083 | 108.3 | 34.71 | 1,309 | 1.0250 | 1,530 |
| Averages, . | 38.3 | 1,025 | 102.5 | 32.99 | 1,182 | 1.0251 | 1,680 |

Weight of animal at beginning of period, . . . . 105.25 lbs.
Weight of animal at end of period, . . . . . 104.50 "

## PERIOD X. SHEEP I.

[Fodder consumed daily: 600 grams hay, 300 grams wheat middlings and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| December 8, . | 30.5 | 825 | 82.5 | 29.24 | 1,606 | 1.0165 | 2,271 |
| 9, . | 29.0 | 934 | 93.4 | 32.60 | 1,929 | 1.0145 | 2,237 |
| 10, . | 37.5 | 912 | 91.2 | 29.48 | 1,416 | 1.0140 | 2,411 |
| 11, . | 32.5 | 877 | 87.7 | 30.16 | 1,799 | - | 2,325 |
| 12, . | 29.0 | 880 | 88.0 | 29.73 | 1,809 | 1.0160 | 2,317 |
| 13, . | 23.5 | 970 | 97.0 | 33.37 | - | - | 2,345 |
| 14, . | 15.0 | 797 | 79.7 | 26.51 | 1,124 | 1.0230 | - |
| Averages, . | 28.1 | 885 | 88.5 | 30.16 | 1,614 | 1.0168 | 2,318 |

Weight of animal at beginning of period, . . . . . 95.00 lbs.
Weight of animal at end of period, . . . . . . 93.75 "

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* See foot-note on page 157.

### PERIOD X. SHEEP IV.

[Fodder consumed daily: 600 grams hay, 300 grams wheat middlings and 5 grams salt.]

| DATE. | Stable Temperature (Fahr.). | Manure excreted Daily. | Sample preserved. | Sample Air Dry. | Urine* excreted Daily, plus Wash Water. | Specific Gravity of Urine. | Water consumed Daily. |
|---|---|---|---|---|---|---|---|
| **1893.** | Degrees. | Grams. | Grams. | Grams. | Grams. | | Grams. |
| December 6, . | 32.0 | 774 | 77.4 | 26.20 | 964 | 1.0260 | 1,479 |
| 7, . | 33.5 | 723 | 72.3 | 25.88 | 1,354 | 1.0240 | 1,285 |
| 8, . | 30.5 | 860 | 86.0 | 31.53 | 932 | 1.0260 | 1,054 |
| 9, . | 29.0 | 784 | 78.4 | 30.30 | 962 | 1.0295 | 1,326 |
| 10, . | 37.5 | 741 | 74.1 | 27.70 | 791 | 1.0400 | 1,077 |
| 11, . | 32.5 | 786 | 78.6 | 28.92 | 975 | - | 1,581 |
| 12, . | 29.0 | 712 | 71.2 | 27.05 | 983 | 1.0300 | 964 |
| Averages, . | 30.6 | 769 | 76.9 | 28.23 | 994 | 1.0293 | 1,267 |

| | |
|---|---|
| Weight of animal at beginning of period, . . . . . | 103.50 lbs. |
| Weight of animal at end of period, . . . . . | 103.25 " |

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* See foot-note on page 157.

The data furnished in the preceding tables enable us to calculate the *coefficients of digestibility* for the various foods, which will be found in the following pages.

## *English Hay (a). Period I.*

### SHEEP II.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 900 grams hay fed, . . . | 758.16 | 229.98 | 26.38 | 84.16 | 367.79 |
| 11.43 grams waste,* . . | 8.88 | 2.47 | 0.26 | 1.05 | 3.76 |
| Total consumed, . . . | 749.28 | 227.51 | 26.12 | 83.11 | 364.03 |
| 320.06 grams manure air dry, | 294.67 | 84.62 | 11.22 | 30.49 | 132.99 |
| Grams digested, . . . | 454.61 | 142.89 | 14.90 | 52.62 | 231.04 |
| Per cent. digested, . . . | 60.67 | 62.80 | 57.04 | 63.31 | 63.46 |

### SHEEP III.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| 900 grams hay fed, . . . | 769.50 | 233.39 | 26.77 | 85.42 | 373.30 |
| 20.71 grams waste,* . . | 15.38 | 2.77 | 0.58 | 2.30 | 7.48 |
| Total consumed, . . . | 754.12 | 230.62 | 26.19 | 83.12 | 365.82 |
| 308.9 grams manure air dry, . | 286.50 | 78.73 | 13.84 | 30.43 | 134.00 |
| Grams digested, . . . | 467.62 | 151.89 | 12.35 | 52.69 | 231.82 |
| Per cent. digested, . . . | 62.00 | 65.86 | 47.15 | 63.39 | 63.37 |

### SHEEP IV.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| 900 grams hay fed, . . . | 769.50 | 233.39 | 26.77 | 85.42 | 373.30 |
| 320.5 grams manure air dry, . | 296.78 | 82.27 | 13.36 | 30.95 | 137.58 |
| Grams digested, . . . | 472.72 | 151.12 | 13.41 | 54.47 | 235.72 |
| Per cent. digested, . . . | 61.43 | 64.73 | 50.09 | 63.76 | 63.14 |
| Average per cent. digested, . | **61.37** | **64.46** | **51.43** | **63.49** | **63.32** |

Average nutritive ratio of ration for three sheep, 1 : 7.79.

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* It will be noticed that in Period I., Sheep II. and III., and in Period II., Sheep II., small amounts of hay (the coarser portions) were not consumed; these amounts were carefully collected, weighed, dry matter tests and complete analyses made.

### *Buffalo Gluten Feed. Period II.*

#### SHEEP II.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 600 grams hay (*a*) fed, . . | 501.06 | 151.97 | 17.44 | 55.62 | 243.06 |
| 12.5 grams waste,* . . . | 9.71 | 2.76 | 0.28 | 1.10 | 4.32 |
| Hay consumed, . . . | 491.35 | 149.21 | 17.16 | 54.52 | 238.74 |
| 300 grams Buffalo gluten feed, | 271.77 | 22.77 | 38.83 | 71.61 | 136.43 |
| Total consumed, . . . | 763.12 | 171.98 | 55.99 | 126.13 | 375.17 |
| 292.55 grams manure air dry, | 259.73 | 69.19 | 14.26 | 30.06 | 116.65 |
| Grams digested, . . . | 503.39 | 102.79 | 41.73 | 96.07 | 258.52 |
| Minus 600 grams hay digested, | 298.10 | 93.70 | 9.79 | 34.52 | 151.50 |
| Buffalo gluten feed digested, . | 205.29 | 9.09 | 31.94 | 61.55 | 107.02 |
| Per cent. digested, . . . | 75.53 | 39.92 | 82.25 | 85.97 | 78.44 |

* See note on preceding page.

#### SHEEP IV.

| | | | | | |
|---|---|---|---|---|---|
| 600 grams hay fed, . . . | 528.30 | 160.23 | 18.38 | 58.65 | 256.28 |
| 250 grams Buffalo gluten feed, | 225.00 | 18.86 | 32.15 | 59.28 | 112.95 |
| Total consumed, . . . | 753.30 | 179.09 | 50.53 | 117.93 | 369.23 |
| 272.28 grams manure air dry, | 247.77 | 66.65 | 15.41 | 30.77 | 112.12 |
| Total digested, . . . | 505.53 | 112.44 | 35.12 | 87.16 | 257.11 |
| Minus 600 grams hay digested, | 324.54 | 103.71 | 9.21 | 37.39 | 161.82 |
| Buffalo gluten feed digested, . | 180.99 | 8.73 | 25.91 | 49.77 | 95.29 |
| Per cent. digested, . . . | 80.44 | 46.28 | 80.58 | 83.94 | 84.37 |
| Average per cent. two sheep digested, . . . . | **77.98** | **43.10** | **81.41** | **84.95** | **81.40** |

Average nutritive ratio of ration for two sheep, 1 : 5.03.

## *English Hay (b). Period III.*

### Sheep I.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 900 grams hay fed, | 765.36 | 250.58 | 23.57 | 82.58 | 348.69 |
| 369.3 grams manure air dry, | 337.95 | 107.00 | 12.81 | 34.64 | 145.89 |
| Amount digested, | 427.41 | 143.58 | 10.76 | 47.94 | 202.80 |
| Per cent. digested, | 55.84 | 57.30 | 45.65 | 58.05 | 58.16 |

### Sheep II.

| | | | | | |
|---|---|---|---|---|---|
| 900 grams hay fed, | 765.36 | 250.58 | 23.57 | 82.58 | 348.69 |
| 375.3 grams manure air dry, | 343.62 | 110.51 | 12.44 | 34.57 | 150.61 |
| Amount digested, | 421.74 | 140.07 | 11.13 | 48.01 | 198.08 |
| Per cent. digested, | 55.10 | 55.90 | 47.22 | 58.13 | 56.80 |

### Sheep III.

| | | | | | |
|---|---|---|---|---|---|
| 900 grams hay fed, | 765.36 | 250.58 | 23.57 | 82.58 | 348.69 |
| 371.54 grams manure air dry, | 339.33 | 106.78 | 12.38 | 36.27 | 145.60 |
| Amount digested, | 426.03 | 143.80 | 11.19 | 46.31 | 203.09 |
| Per cent. digested, | 55.56 | 57.38 | 47.47 | 56.08 | 58.24 |

### Sheep IV.

| | | | | | |
|---|---|---|---|---|---|
| 900 grams hay fed, | 765.36 | 250.58 | 23.57 | 82.58 | 348.69 |
| 371.77 grams manure air dry, | 337.83 | 105.30 | 12.43 | 35.47 | 145.77 |
| Amount digested, | 427.53 | 145.28 | 11.14 | 47.11 | 202.92 |
| Per cent. digested, | 55.86 | 57.98 | 47.26 | 57.04 | 58.19 |
| Average per cent. four sheep digested, | **55.57** | **57.14** | **46.90** | **57.32** | **57.85** |

Average nutritive ratio of ration for three sheep, 1 : 7.89.

By feeding the following grains in connection with English hay (*b*) we are enabled to find their coefficients of digestibility.

### *New-process Linseed Meal. Period IV.*

SHEEP II.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 600 grams hay fed, . . . | 526.38 | 172.34 | 16.21 | 56.79 | 239.82 |
| 250 grams new-process linseed meal, . . . . | 220.70 | 18.96 | 8.85 | 89.16 | 90.84 |
| Total consumed, . . . | 747.08 | 191.30 | 25.06 | 145.95 | 330.66 |
| 297.01 grams manure air dry, | 280.76 | 85.63 | 9.40 | 35.96 | 116.01 |
| Amount digested, . . . | 466.32 | 105.67 | 15.66 | 109.99 | 214.65 |
| Minus 600 grams hay digested, | 290.06 | 96.33 | 7.65 | 33.02 | 136.24 |
| Remains linseed meal digested, | 176.26 | 9.34 | 8.01 | 76.97 | 78.41 |
| Per cent. digested, . . . | 79.86 | 49.24 | 90.50 | 86.32 | 86.31 |

SHEEP III.

| | | | | | |
|---|---|---|---|---|---|
| Total consumed, as above, . | 747.08 | 191.30 | 25.06 | 145.95 | 330.66 |
| 288.81 grams manure air dry, | 271.77 | 78.52 | 9.27 | 35.49 | 114.04 |
| Total digested, . . . | 475.31 | 112.78 | 15.79 | 110.46 | 216.62 |
| Minus 600 grams hay digested, | 293.01 | 98.90 | 7.69 | 31.85 | 139.67 |
| Remains linseed meal digested, | 182.30 | 13.88 | 8.10 | 78.61 | 76.95 |
| Per cent. digested, . . . | 82.60 | 73.21 | 91.52 | 88.16 | 84.71 |
| Average per cent. two sheep digested, . . . . . | **81.23** | **61.23** | **91.01** | **87.24** | **85.51** |

Average nutritive ratio of ration for two sheep, 1 : 3.30.

## *Old-process Linseed Meal. Period V.*

### SHEEP II.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 600 grams hay fed, . . . | 517.38 | 169.42 | 15.94 | 55.83 | 235.72 |
| 250 grams old-process linseed meal, . . . . | 218.18 | 17.91 | 18.04 | 80.18 | 86.83 |
| Total consumed, . . . | 735.56 | 187.33 | 33.98 | 136.01 | 322.55 |
| 301.43 grams manure air dry, . | 285.76 | 85.87 | 9.86 | 34.29 | 120.62 |
| Total digested, . . . | 449.80 | 101.46 | 24.12 | 101.72 | 201.93 |
| Minus 600 grams hay digested, | 285.10 | 94.69 | 7.52 | 32.46 | 133.91 |
| Remains old-process linseed meal digested, . . . | 164.70 | 6.77 | 16.60 | 69.26 | 68.02 |
| Per cent. digested, . . . | 75.48 | 37.80 | 92.01 | 86.38 | 78.33 |

### SHEEP III.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| Total consumed, as above, . | 735.56 | 187.33 | 33.98 | 136.01 | 322.55 |
| 283.20 grams manure air dry, | 268.10 | 77.32 | 11.02 | 29.84 | 116.89 |
| Total digested, . . . | 467.46 | 110.01 | 22.96 | 106.17 | 205.66 |
| Minus 600 grams hay digested, | 288.00 | 97.21 | 7.57 | 31.31 | 137.29 |
| Remains old-process linseed meal digested, . . . | 179.46 | 12.80 | 15.39 | 74.86 | 68.37 |
| Per cent. digested, . . . | 82.25 | 71.47 | 85.30 | 93.36 | 78.73 |

### SHEEP IV.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| 600 grams hay consumed, . | 526.38 | 172.34 | 16.21 | 56.79 | 239.82 |
| 250 grams old-process linseed meal, . . . . . | 220.00 | 18.06 | 18.19 | 80.85 | 87.56 |
| Total consumed, . . . | 746.38 | 190.40 | 34.40 | 137.64 | 327.38 |
| 296.2 grams manure air dry, . | 280.20 | 79.32 | 10.65 | 35.19 | 121.64 |
| Total digested, . . . | 466.18 | 111.08 | 23.75 | 102.45 | 205.74 |
| Minus 600 grams hay digested, | 294.04 | 99.92 | 7.66 | 32.40 | 139.56 |
| Remains old-process linseed meal digested, . . . | 172.14 | 11.16 | 16.09 | 70.05 | 66.18 |
| Per cent. digested, . . . | 78.24 | 61.79 | 88.45 | 86.64 | 75.58 |
| Average per cent. three sheep digested, . . . . | **78.66** | **57.02** | **88.59** | **88.79** | **77.55** |

Average nutritive ratio of ration for three sheep, 1 : 3.59.

### *Corn (Maize) Cobs. Period VI.*

SHEEP I.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 450 grams hay fed, . . . | 384.03 | 125.72 | 11.83 | 41.44 | 174.96 |
| 400 grams corn cobs, . . | 351.56 | 95.51 | 4.50 | 13.57 | 231.21 |
| 250 grams new-process linseed meal, . . . . . | 220.25 | 18.92 | 8.83 | 88.98 | 90.65 |
| Total consumed, . . . | 955.84 | 240.15 | 25.16 | 143.99 | 496.82 |
| 381.8 grams manure air dry, . | 353.05 | 97.19 | 9.25 | 40.14 | 177.23 |
| Total digested, . . . | 602.79 | 142.96 | 15.91 | 103.85 | 319.59 |
| Minus 450 grams hay digested, . . . . | 390.34 | 81.36 | 13.39 | 100.88 | 180.00 |
| Minus 250 grams new-process linseed meal digested, . | | | | | |
| Remains corn cobs digested, . | 212.45 | 61.60 | 2.52 | 2.97 | 139.59 |
| Per cent. digested, . . . | 60.43 | 64.50 | 56.00 | 21.88 | 60.37 |
| SHEEP II. | | | | | |
| 400 grams hay fed, . . . | 334.48 | 109.50 | 10.30 | 36.09 | 152.39 |
| 400 grams corn cobs, . . | 351.56 | 95.51 | 4.50 | 13.57 | 231.21 |
| 200 grams new-process linseed meal, . . . . . | 177.14 | 15.22 | 7.10 | 71.56 | 72.91 |
| Total consumed, . . . | 863.18 | 220.23 | 21.90 | 121.22 | 456.51 |
| 362.94 grams manure air dry, | 331.73 | 88.34 | 8.62 | 36.72 | 168.95 |
| Total digested, . . . | 531.45 | 131.89 | 13.28 | 84.50 | 287.56 |
| Minus 400 grams hay digested, | 325.76 | 68.70 | 11.29 | 82.75 | 149.49 |
| Minus 200 grams new-process linseed meal digested, . | | | | | |
| Remains corn cobs digested, . | 205.69 | 63.19 | 1.99 | 1.75 | 138.07 |
| Per cent. digested, . . . | 58.51 | 66.16 | 44.22 | 12.89 | 59.71 |
| Average per cent. two sheep digested, . . . . | **59.47** | **65.33** | **50.11** | **17.38** | **60.04** |

Nutritive ratio of ration, Sheep I., 1 : 4.84; nutritive ratio of ration, Sheep II., 1 : 5.36.

### *Dried Brewers' Grains. Period VII.*

#### SHEEP I.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 500 grams hay fed, . . . | 433.00 | 141.76 | 13.34 | 46.72 | 197.27 |
| 400 grams brewers' grains, . | 358.72 | 52.09 | 28.02 | 82.47 | 183.27 |
| Total consumed, . . . | 791.72 | 193.85 | 41.36 | 129.19 | 380.54 |
| 344.9 grams manure air dry, . | 328.83 | 83.91 | 9.27 | 37.98 | 158.23 |
| Total digested, . . . | 462.89 | 109.94 | 32.09 | 91.21 | 222.31 |
| Minus 500 grams hay digested, | 241.79 | 81.23 | 6.09 | 27.12 | 114.73 |
| Remains brewers' grains digested, . . . . . | 221.10 | 28.71 | 26.00 | 64.09 | 107.58 |
| Per cent. digested, . . . | 61.63 | 55.11 | 92.79 | 77.71 | 58.70 |

#### SHEEP II.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein | Extract Matter. |
|---|---|---|---|---|---|
| Total consumed, as above, . | 791.72 | 193.85 | 41.36 | 129.19 | 380.54 |
| 355.47 grams manure air dry, | 331.87 | 88.54 | 10.00 | 35.38 | 160.42 |
| Total digested, . . . | 459.85 | 105.31 | 31.36 | 93.81 | 220.12 |
| Minus 500 grams hay digested, | 238.59 | 79.24 | 6.30 | 27.16 | 112.05 |
| Remains brewers' grains digested, . . . . . | 221.26 | 26.07 | 25.06 | 66.65 | 108.07 |
| Per cent. digested, . . . | 61.68 | 50.04 | 89.43 | 80.82 | 58.96 |
| Average per cent. two sheep digested, . . . . | **61.65** | **52.57** | **91.11** | **79.26** | **57.83** |

Average nutritive ratio of ration for two sheep, 1 : 4.40.

## *Spring Wheat Bran. Period VIII.*

### SHEEP II.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 600 grams hay fed, . . . | 523.44 | 171.37 | 16.12 | 56.48 | 238.48 |
| 300 grams spring-wheat bran, | 261.93 | 30.07 | 14.14 | 46.07 | 155.56 |
| Total consumed, . . . | 785.37 | 201.44 | 30.26 | 102.55 | 394.04 |
| 350.97 grams manure air dry, | 333.84 | 98.98 | 11.95 | 33.92 | 150.36 |
| Total digested, . . . | 451.53 | 102.46 | 18.31 | 68.63 | 243.68 |
| Minus 600 grams hay digested, | 288.44 | 95.79 | 7.61 | 32.84 | 135.48 |
| Remains spring-wheat bran digested, . . . . | 163.09 | 6.67 | 10.70 | 35.79 | 108.20 |
| Per cent. digested, . . . | 62.26 | 22.18 | 75.67 | 77.68 | 69.55 |

### SHEEP III.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| Total consumed, as above, . | 785.37 | 201.44 | 30.26 | 102.55 | 394.04 |
| 346.69 grams manure air dry, | 329.49 | 95.58 | 11.93 | 33.28 | 144.35 |
| Total digested, . . . | 455.88 | 105.86 | 18.33 | 69.27 | 249.69 |
| Minus 600 grams hay digested, | 291.38 | 98.34 | 7.65 | 31.68 | 138.90 |
| Remains spring-wheat bran digested, . . . . | 164.50 | 7.52 | 10.68 | 37.59 | 110.79 |
| Per cent. digested, . . . | 62.80 | 0.25 | 75.53 | 81.59 | 71.22 |
| Average per cent. two sheep digested, . . . . | **62.53** | **23.59** | **75.60** | **79.63** | **70.38** |

Nutritive ratio of ration for two sheep, 1 : 5.75.

### *Winter-Wheat Bran. Period IX.*

### SHEEP IV.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 600 grams hay fed, . . . | 517.38 | 169.39 | 15.94 | 55.82 | 235.72 |
| 300 grams winter-wheat bran, | 259.47 | 24.18 | 11.86 | 44.22 | 163.03 |
| Total consumed, . . . | 776.86 | 193.57 | 27.80 | 100.04 | 398.75 |
| 329.94 grams manure air dry, | 315.42 | 81.75 | 13.09 | 33.47 | 146.74 |
| Total digested, . . . | 461.43 | 111.82 | 14.71 | 66.57 | 252.01 |
| Minus 600 grams hay digested, | 289.01 | 98.21 | 7.53 | 31.84 | 137.18 |
| Remains winter-wheat bran digested, . . . . . | 172.42 | 13.61 | 7.18 | 34.73 | 114.83 |
| Per cent. digested, . . . | **66.45** | **56.28** | **60.54** | **78.54** | **70.43** |

Nutritive ratio of ration, 1 : 6.02.

### *Wheat Middlings.*

#### SHEEP I.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| | Grams. | Grams. | Grams. | Grams. | Grams. |
| 600 grams hay fed, . . . | 523.44 | 171.37 | 16.12 | 56.48 | 238.48 |
| 300 grams wheat middlings, . | 260.82 | 9.21 | 15.91 | 54.93 | 176.86 |
| Total consumed, . . . | 784.26 | 180.58 | 32.03 | 111.41 | 415.34 |
| 301.56 grams manure air dry, | 284.64 | 79.39 | 10.67 | 33.67 | 127.32 |
| Total digested, . . . | 499.62 | 101.19 | 21.36 | 77.74 | 288.02 |
| Minus 600 grams hay digested, | 292.30 | 98.19 | 7.36 | 32.79 | 138.70 |
| Remains wheat middlings digested, . . . . | 207.32 | 3.00 | 14.00 | 44.95 | 149.32 |
| Per cent. digested, . . . | 79.48 | 32.57 | 87.99 | 81.83 | 84.43 |

#### SHEEP IV.

| | Dry Matter. | Crude Cellulose. | Crude Fat. | Crude Protein. | Extract Matter. |
|---|---|---|---|---|---|
| Total consumed, as above, . | 784.26 | 180.58 | 32.03 | 111.41 | 415.34 |
| 282.26 grams manure air dry, | 268.51 | 77.54 | 11.41 | 30.99 | 115.46 |
| Total digested, . . . | 515.75 | 103.04 | 20.62 | 80.42 | 299.88 |
| Minus 600 grams hay digested, | 292.40 | 99.35 | 7.62 | 32.22 | 138.78 |
| Remains wheat middlings digested, . . . . | 223.35 | 3.69 | 13.00 | 48.20 | 161.10 |
| Per cent. digested, . . . | 85.63 | 40.06 | 81.71 | 87.75 | 91.08 |
| Average per cent. two sheep digested, . . . . | **82.55** | **36.31** | **84.85** | **84.79** | **87.75** |

Average nutritive ratio of ration for both sheep, 1 : 5.61.

A *résumé* of the coefficients will be found on page 152.

A compilation of the results of all digestion experiments made in the United States will be found in the rear portion of this report.

# VII.

# NOTES ON FEEDING FARM HORSES.

## 1888–93.

### RATIONS FOR FARM HORSES.

The following data are presented in order to show how the horses kept at the station have been fed during the past few years. The two farm horses, Fan and Bess, do an average amount of work during the spring, summer and autumn. In the winter season the work is light. Molly, whose record first appears in January, 1892, has been used for driving and express work.

During the winter of 1892, when the horses had comparatively little to do, the grain rations were reduced one-third. The so-called provender consists of cracked corn and oats mixed in the proportion of four hundred pounds of corn to fifteen bushels of oats. The horses were weighed weekly, and the average monthly weights will be found in Table III. The horses have been in uniform good condition during the several years.

*Table I.* (*Horses Fan, Bess and Molly.*)

| Ration. | | Food consumed Daily (Pounds). | | | Nutritive Ratio. | Total Dry Matter (Pounds). | Total Digestible Matter (Pounds). | Cost per Day (Cents). |
|---|---|---|---|---|---|---|---|---|
| | | Hay. | Wheat Bran. | Provender. | | | | |
| I., | Aug., 1888, to June, 1889, | 18.00 | 2.00 | 6.00 | 1:7.92 | 23.23 | 14.39 | 23.34 |
| II., | June, 1889, to Jan., 1892, | 20.00 | 2.00 | 6.00 | 1:7.99 | 25.03 | 15.41 | 24.84 |
| III., | Jan., 1892, to May, 1892, | 15.00 | 2.00 | 4.00 | 1:7.22 | 18.78 | 11.42 | 18.49 |
| IV., | May, 1892, to Jan., 1894, | 15.00 | 3.00 | 6.00 | 1:7.81 | 21.43 | 13.26 | 22.09 |

The above table shows the daily rations fed during the several years, the nutritive ratios of the feed, the average amount of dry matter and digestible matter consumed daily and the average daily cost of the rations.

The following table shows the pounds of digestible nutrients in Ration IV., as compared with Wolff's standard for horses of one thousand pounds live weight, doing average work and hard work: —

*Table II.*

| | Digestible Protein (Pounds). | Digestible Fat (Pounds). | Digestible Carbohydrates (Pounds). | Total Digestible Matter (Pounds). | Nutritive Ratio. |
|---|---|---|---|---|---|
| Ration IV., . . . . | 1.58 | 0.43 | 11.25 | 13.26 | 1:7.81 |
| Wolff's standard, average work, . . . . . | 1.55 | 0.55 | 10.85 | 12.95 | 1:7.80 |
| Wolff's standard, very hard work, . . . . . | 2.12 | 0.83 | 12.63 | 15.58 | 1:7.00 |

Table III., showing Average Monthly Weight of the Horses (Pounds).

| Ration. | Year. | Name of Horse. | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I., | 1888, | Fan, | – | – | – | – | – | – | – | 1,089 | 1,090 | 1,103 | 1,101 | 1,115 |
| I., | 1888, | Bess, | – | – | – | – | – | – | – | 1,107 | 1,115 | 1,115 | 1,116 | 1,126 |
| I., | 1889, | Fan, | 1,108 | 1,104 | 1,104 | 1,114 | 1,095 | – | – | – | – | – | – | – |
| I., | 1889, | Bess, | 1,109 | 1,092 | 1,101 | 1,123 | 1,116 | – | – | – | – | – | – | – |
| II., | 1889, | Fan, | – | – | – | – | – | 1,110 | 1,083 | 1,082 | 1,079 | 1,086 | 1,101 | 1,106 |
| II., | 1889, | Bess, | – | – | – | – | – | 1,129 | 1,108 | 1,095 | 1,108 | 1,103 | 1,118 | 1,109 |
| II., | 1890, | Fan, | 1,131 | 1,119 | 1,112 | 1,098 | 1,120 | 1,123 | 1,127 | 1,124 | 1,102 | 1,108 | 1,108 | 1,119 |
| II., | 1890, | Bess, | 1,120 | 1,126 | 1,119 | 1,110 | 1,119 | 1,118 | 1,129 | 1,134 | 1,125 | 1,121 | 1,126 | 1,107 |
| II., | 1891, | Fan, | 1,111 | 1,106 | 1,107 | 1,105 | 1,103 | 1,100 | 1,114 | 1,100 | 1,101 | 1,121 | 1,125 | 1,138 |
| II., | 1891, | Bess, | 1,110 | 1,077 | 1,099 | 1,097 | 1,109 | 1,115 | 1,126 | 1,120 | 1,117 | 1,126 | 1,137 | 1,144 |
| III., | 1892, | Fan, | 1,108 | 1,122 | 1,117 | 1,113 | – | – | – | – | – | – | – | – |
| III., | 1892, | Molly, | 1,062 | 1,063 | 1,063 | 1,038 | – | – | – | – | – | – | – | – |
| III., | 1892, | Bess, | 1,143 | 1,145 | 1,129 | 1,126 | – | – | – | – | – | – | – | – |
| IV., | 1892, | Fan, | – | – | – | – | 1,119 | 1,098 | 1,078 | 1,094 | 1,075 | 1,103 | 1,102 | 1,099 |
| IV., | 1892, | Molly, | – | – | – | – | 1,037 | 1,019 | 1,085 | 1,036 | 1,057 | 1,056 | 1,066 | 1,085 |
| IV., | 1892, | Bess, | – | – | – | – | 1,127 | 1,112 | 1,101 | 1,108 | 1,081 | 1,086 | 1,084 | 1,107 |
| IV., | 1893, | Fan, | 1,103 | 1,135 | 1,124 | 1,133 | 1,126 | 1,114 | 1,104 | 1,100 | 1,076 | 1,087 | 1,111 | 1,111 |
| IV., | 1893, | Molly, | 1,090 | 1,095 | 1,085 | 1,076 | 1,074 | 1,070 | 1,068 | 1,082 | 1,053 | 1,083 | 1,080 | 1,113 |
| IV., | 1893, | Bess, | 1,111 | 1,092 | 1,062 | 1,071 | 1,078 | 1,040 | 1,070 | 1,065 | 1,065 | 1,033 | 1,080 | 1,101 |

## REMARKS.

It will be noticed that the average weight of the horses has been well sustained by the various rations fed. Table III. makes this very clear. Slight variations are noted at times, due probably to the fact that the horses were obliged to do rather more than the average work for a short time.

Ration III., fed when the horses were doing very light work, proved sufficient to keep them in good condition, and costs several cents less per day than the others. Ration IV. gives very good results, and costs somewhat less than Rations I. and II. The cost of the several rations is based on an approximate average market cost of the several foods. This average will be found below. Ration IV. contains about the same amount of digestible nutrients as given by Wolff for horses doing average work.

*Average Market Cost of the Various Foods fed.*

| | |
|---|---|
| Hay, | $15 00 per ton. |
| Wheat bran, | 20 00 " |
| Cracked corn, | 24 00 " |
| Oats (thirty-two pounds per bushel), | 0 45 per bushel. |

*Average Composition of Fodder Stuffs.*

| | Hay. | Wheat Bran. | Provender. |
|---|---|---|---|
| Moisture at 100° C., | 10.15 | 10.49 | 12.16 |
| Dry matter, | 89.85 | 89.51 | 87.84 |
| | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | |
| Crude ash, | 6.21 | 7.01 | 2.58 |
| " cellulose, | 32.15 | 10.89 | 6.96 |
| " fat, | 2.38 | 5.00 | 5.11 |
| " protein, | 9.67 | 17.78 | 12.25 |
| Non-nitrogenous extract matter, | 49.59 | 59.32 | 73.04 |
| | 100.00 | 100.00 | 100.00 |

# PART II.

# FIELD EXPERIMENTS.

C. A. GOESSMANN.

1. FIELD EXPERIMENTS TO ASCERTAIN THE EFFECT OF THE EXCLUSION OF EVERY FORM OF NITROGEN-CONTAINING MANURIAL MATTER FROM THE FERTILIZER APPLIED FOR THE PRODUCTION OF A GRAIN CROP — OATS — ON ITS YIELD PER ACRE (FIELD A).
2. FIELD EXPERIMENTS WITH PROMINENT VARIETIES OF GRASSES AND GRASS MIXTURES UNDER FAIRLY CORRESPONDING CIRCUMSTANCES AND WITH DIFFERENT VARIETIES OF POTATOES (FIELD B).
3. FIELD EXPERIMENTS REGARDING THE EFFECT OF DIFFERENT COMBINATIONS OF COMMERCIAL FERTILIZERS ON THE YIELD OF SOME PROMINENT GARDEN CROPS (FIELD C).
4. OBSERVATIONS REGARDING THE ADAPTATION OF A VARIETY OF MORE OR LESS REPUTED FODDER PLANTS NEW TO OUR SECTION OF THE COUNTRY (FIELD D).
5. FIELD EXPERIMENTS WITH DIFFERENT COMMERCIAL PHOSPHATES, TO STUDY THE ECONOMY OF USING THE CHEAPER NATURAL PHOSPHATES OR THE MORE COSTLY ACIDULATED PHOSPHATES (FIELD F).
6. FIELD EXPERIMENTS TO SHOW THE EFFECT OF BARN-YARD MANURE ON THE YIELD OF CORN (FIELD G).
7. FIELD EXPERIMENTS TO DETERMINE THE EFFECT OF VARIOUS FERTILIZER MIXTURES ON LEGUMINOUS AND GRAIN CROPS (EAST FIELD).
8. OBSERVATIONS ON PERMANENT GRASS LANDS — MEADOWS.
9. REPORT ON GENERAL FARM WORK.
10. OBSERVATIONS ON SPECIAL FERTILIZATION WITH REFERENCE TO SOME PROMINENT INDUSTRIAL CROPS, FRUITS AND GARDEN VEGETABLES.

## 1. Field Experiments carried on for the Purpose of ascertaining the Effect of the Exclusion of Every Form of Nitrogen-containing Manurial Matter from the Fertilizer applied for the Production of Oats on the Yield, as compared with the Results obtained when a Liberal Amount of Various Nitrogen-containing Manurial Substances is applied under Otherwise Corresponding Circumstances for the Same Purpose.

### *Field A.*

The unbroken record of this field extends over more than twenty years. The systematic treatment of the soil, as far as suitable modes of cultivation and of manuring are concerned, was introduced during the season of 1883–84. The subdivision of the entire area into eleven plats (one-eighth of an acre each), of a uniform size and shape, one hundred and thirty feet long and thirty feet wide, with an unoccupied and unmanured space of five feet in width between adjoining plats, has been retained unaltered since 1884. A detailed statement of the particular aim and general management of our experiments, as well as of the results obtained in that connection from year to year, forms a prominent part of our contemporary printed annual reports, to which I have to refer for details.

*Since 1889 the main object of observations upon the same field has been to study the influence of an entire exclusion of any additional nitrogen-containing manurial substance from the soil under cultivation, as well as of a definite additional supply of nitrogen in different forms of combination, on the character and yield of the crop selected for the trial.* The treatment of the soil adopted in preceding years favored this new project for field observations, as may be noticed from the following remarks.

Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes were retained in that state, to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation, while the remaining ones received as before a definite amount of nitrogen in the same form in which they had received it in preceding years; namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood or of barn-yard manure. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received without an exception a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate.

*Amount of Fertilizing Ingredients used Annually per Acre.*

| | | |
|---|---|---|
| Plats 0, 1, 2, 3, 5, 6, 8, 10, | Nitrogen, | 45 pounds. |
| | Phosphoric acid, | 80 pounds. |
| | Potassium oxide, | 125 pounds. |
| Plats 4, 7, 9, | Nitrogen, | none. |
| | Phosphoric acid, | 80 pounds. |
| | Potassium oxide, | 125 pounds. |

One plat marked 0 received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of the three essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate and 18 pounds of dissolved bone-black.

The mechanical preparation of the soil, the incorporation of the manurial substances, — the general character of the latter being the same, — the seeding, cultivating and harvesting were carried on year after year in a like manner, and as far as practicable on the same day in case of every plat during the same year.

The subsequent tabular statement shows the annual application and special distribution of the manurial substances with reference to each plat since 1889. The fertilizers were in every case applied broadcast as early as circumstances permitted. They were well harrowed under before the seed was planted in rows by a seed drill.

| PLATS. | Annual Supply of Manurial Substances. |
|---|---|
| Plat 0, | 800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black. |
| Plat 1, . | 29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 2, . | 29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 3, . | 43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 4, . | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 5, . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 6, . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 7, . | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 8, . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 9, . | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 10, . | 43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |

*Cost of Fertilizers applied to Field A.*

| | Cost per Plat. | Cost per Acre. |
|---|---|---|
| Plat 0, . . . . . . . . . | $2 28 | $22 75 |
| Plat 1, . . . . . . . . . | 1 99 | 19 90 |
| Plat 2, . . . . . . . . . | 2 43 | 24 30 |
| Plat 3, . . . . . . . . . | 2 09 | 20 90 |
| Plat 4, . . . . . . . . . | 1 23 | 12 30 |
| Plat 5, . . . . . . . . . | 2 46 | 24 58 |
| Plat 6, . . . . . . . . . | 2 02 | 20 18 |
| Plat 7, . . . . . . . . . | 1 23 | 12 30 |
| Plat 8, . . . . . . . . . | 2 02 | 20 18 |
| Plat 9, . . . . . . . . . | 1 23 | 12 30 |
| Plat 10, . . . . . . . . . | 2 53 | 25 30 |

The above-described course of the general management of the experiment has been followed thus far for five consecutive years (1889–93, inclusive).

*Kind of Crops raised.*

| | |
|---|---|
| Corn (maize), | in 1889. |
| Oats, | in 1890. |
| Rye, | in 1891. |
| Soja bean, | in 1892. |
| Oats, | in 1893. |

For details regarding earlier years (1889–92), see corresponding annual reports.

*Summary of Four Years' Observations upon Field A (1889–92).*

| Number of Plat. | 1889. Corn. | 1890. Yield of Oats. | | | | | 1891. Yield of Rye. | | | | | 1892. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yield of Dry Fodder Corn (Pounds). | Crop (Pounds). | Percentage of Grain. | Percentage of Straw and Chaff. | Yield of Grain (Pounds). | Yield of Straw (Pounds). | Crop (Pounds). | Percentage of Grain. | Percentage of Straw and Chaff. | Yield of Grain (Pounds). | Yield of Straw (Pounds). | Yield of Green Soja Bean (Pounds). |
| Plat 0, . | – | 315 | 38.10 | 61.90 | 120 | 195 | 470 | 30.21 | 69.79 | 142 | 328 | 2,210 |
| Plat 1, . | 648 | 362 | 35.36 | 64.64 | 128 | 234 | 570 | 27.02 | 72.98 | 154 | 416 | 2,290 |
| Plat 2, . | 577 | 365 | 35.34 | 64.66 | 129 | 236 | 525 | 25.52 | 74.48 | 134 | 391 | 2,290 |
| Plat 3, . | 618 | 345 | 33.62 | 66.38 | 116 | 229 | 475 | 27.37 | 72.63 | 130 | 345 | 2,090 |
| Plat 4, . | 381 | 260 | 34.61 | 63.39 | 90 | 170 | 390 | 27.44 | 72.56 | 107 | 283 | 1,440 |
| Plat 5, . | 488 | 360 | 39.20 | 60.80 | 141 | 219 | 530 | 27.36 | 72.64 | 145 | 385 | 1,935 |
| Plat 6, . | 542 | 385 | 32.21 | 67.79 | 124 | 261 | 400 | 25.50 | 74.50 | 102 | 298 | 1,970 |
| Plat 7, . | 526 | 320 | 34.40 | 65.60 | 110 | 210 | 450 | 24.22 | 75.78 | 109 | 341 | 1,430 |
| Plat 8, . | 359 | 220 | 26.82 | 73.18 | 59 | 161 | – | – | – | – | – | 1,450 |
| Plat 9, . | 476 | 290 | 34.83 | 65.17 | 101 | 189 | 425 | 25.65 | 74.35 | 109 | 316 | 1,460 |
| Plat 10, . | 640 | 395 | 35.44 | 64.56 | 140 | 255 | 425 | 29.41 | 70.59 | 125 | 300 | 1,490 |

Plat 8 has shown, as has been repeatedly pointed out throughout the entire experiment, exceptional conditions, due apparently to injury by insects in the early stage of the growth.

The low yield of Plat 10 in 1892 is evidently due to the use of a lower rate of seed, being the first plat to adjust the seed drill for a definite amount of seed.

An examination of the above tabular statement of the annual yield of the various crops upon the different plate shows that as a rule those plats (4, 7, 9) which had not received in any form nitrogen for manurial purposes yielded much smaller crops than those that received annually in some form or other an addition of available nitrogen. It seemed but proper to sum up in our last annual report our results in the following statement: —

*The experiments carried on upon Field A during the years 1889, '90, '91 and '92 show conclusively the importance of a liberal supply to the soil of an available form of nitrogen, to serve a successful and remunerative cultivation of farm crops under otherwise corresponding favorable conditions. For even a leguminous crop, the soja bean, when for the first time raised upon Field A, did not furnish an exception to our observation.*

The stated conclusion is in full accord with careful observations of others when raising upon a field for the first time clover or clover-like plants. A deficiency of the soil in regard to the peculiar lower organisms, which in case of clover-like plants are recognized as the medium to assist in the conversion of the atmospheric nitrogen into nitrogenous plant food, is usually considered the cause of the results. This class of crops frequently does better on a second trial upon the same lands.

A liberal introduction of annual leguminous crops into our system of raising field crops is known to improve the nitrogen resources of the farm lands in an economical way.

*1893.* — The main object of our experiment upon Field A during this season was to observe the after-effect of the cultivation of soja bean (a leguminous crop) on the nitrogen resources of the soil which served for its production. It seemed of interest in our case to ascertain whether the raising of the soja bean upon Field A had increased the amount of available nitrogen stored up in the soil to such an extent as to affect the yield of the succeeding crop upon those plats (4, 7, 9), which as a rule did not receive at any time an addition of available nitrogen from any other manurial source but the atmospheric air and the roots of the soja beans left in the soil after harvesting the crop.

Oats were selected as the crop suitable to serve for that purpose. The general management of the experiment, as far as the preparation of the soil, manuring and seeding-down are concerned, was the same as in preceding years, as will be seen from the subsequent description of the operation.

The field was ploughed Sept. 22, 1892; during the succeeding March the barn-yard manure was applied broadcast to Plat 0, and April 29 the entire field was again ploughed. The remaining plats, 1–10, received their different fertilizer mixtures broadcast on May 4. The entire field was harrowed and pulverized a few days later. The oats were sown May 15, in drills two and a half feet apart, at the rate of three and two-thirds pounds per plat. The seed when tested by germination showed eighty-two per cent. of live seed. The young plants appeared above ground May 22. June 2 and again June 17 all plats were cultivated and hoed.

*Height of the Oats upon the Different Plats of Field A during the Season (1893).*

[Inches.]

| | July 3. | July 10. | July 17. | July 24. | July 31. | August 7. |
|---|---|---|---|---|---|---|
| Plat 0, . . . | 20 | 25 | 34 | 44 | 44 | 45 |
| Plat 1, . . . | 23 | 30 | 39 | 45 | 46 | 46 |
| Plat 2, . . . | 24 | 27 | 39 | 44 | 46 | 46 |
| Plat 3, . . . | 20 | 27 | 38 | 44 | 46 | 47 |
| Plat 4, . . . | 18 | 20 | 34 | 36 | 40 | 41 |
| Plat 5, . . . | 23 | 24 | 36 | 45 | 45 | 46 |
| Plat 6, . . . | 20 | 23 | 33 | 40 | 43 | 47 |
| Plat 7, . . . | 19 | 23 | 36 | 41 | 44 | 46 |
| Plat 8, . . . | 14 | 17 | 29 | 35 | 40 | 46 |
| Plat 9, . . . | 19 | 22 | 35 | 38 | 42 | 44 |
| Plat 10, . . . | 23 | 31 | 39 | 47 | 48 | 48 |

The color of the crop varied on different plats considerably throughout the season. Those receiving no nitrogen appeared yellowish-green, while those which received nitrogen in the form of dried blood were especially dark-green colored. The crop raised on the plats which received nitrogen in the form of sulphate of ammonia retained the green color somewhat longer than that of the remaining plats.

The crop was cut August 14, 15.

*Yield of Oat Crop on Different Plats (1893).*

[Pounds.]

| | Weight of Oats. | Weight of Oats per Acre. | Weight of Straw and Chaff. | Weight of Grain. | Weight of Straw and Chaff per Acre. | Weight of Grain per Acre. |
|---|---|---|---|---|---|---|
| Plat 0, . . . | 530 | 5,300 | 399 | 131 | 3,990 | 1,310 |
| Plat 1, . . . | 690 | 6,900 | 555 | 135 | 5,550 | 1,350 |
| Plat 2, . . . | 600 | 6,000 | 454 | 146 | 4,540 | 1,460 |
| Plat 3, . . . | 700 | 7,000 | 534 | 166 | 5,340 | 1,660 |
| Plat 4, . . . | 590 | 5,900 | 430 | 160 | 4,300 | 1,600 |
| Plat 5, . . . | 630 | 6,300 | 551 | 79 | 5,510 | 790 |
| Plat 6, . . . | 600 | 6,000 | 498 | 102 | 4,980 | 1,020 |
| Plat 7, . . . | 550 | 5,500 | 431 | 119 | 4,310 | 1,190 |
| Plat 8, . . . | 420 | 4,200 | 325 | 95 | 3,250 | 950 |
| Plat 9, . . . | 480 | 4,800 | 370 | 110 | 3,700 | 1,100 |
| Plat 10, . . . | 610 | 6,100 | 485 | 125 | 4,850 | 1,250 |

*Ratio of Grain to Straw.*

| | | | |
|---|---|---|---|
| Plat 0, . . . . | 1:3 | Plat 6, . . . . | 1:4.9 |
| Plat 1, . . . . | 1:4.1 | Plat 7, . . . . | 1:3.6 |
| Plat 2, . . . . | 1:3.1 | Plat 8, . . . . | 1:3.4 |
| Plat 3, . . . . | 1:3.2 | Plat 9, . . . . | 1:3.4 |
| Plat 4, . . . . | 1:2.7 | Plat 10, . . . . | 1:3.9 |
| Plat 5, . . . . | 1:7 | | |

*Conclusions.* — An examination of the results given above shows that the total crop on those plats to which no nitrogen was applied (4, 7 and 9) averaged 800 pounds less than in case of the plats which received their regular supply of nitrogen in some form or other.

Plat 8 shows again the exceptional conditions of previous years, for, although fertilized in a like manner as Plat 6, its total yield was 1,800 pounds less.

In yield of grain those plats which received their nitrogen in the form of sulphate of ammonia (5, 6 and 8) averaged 92 pounds; those in the form of organic nitrogen (0, 6 and 8), 140$\frac{2}{3}$ pounds; those in the form of nitrate of soda (1 and 2), 140$\frac{1}{2}$ pounds.

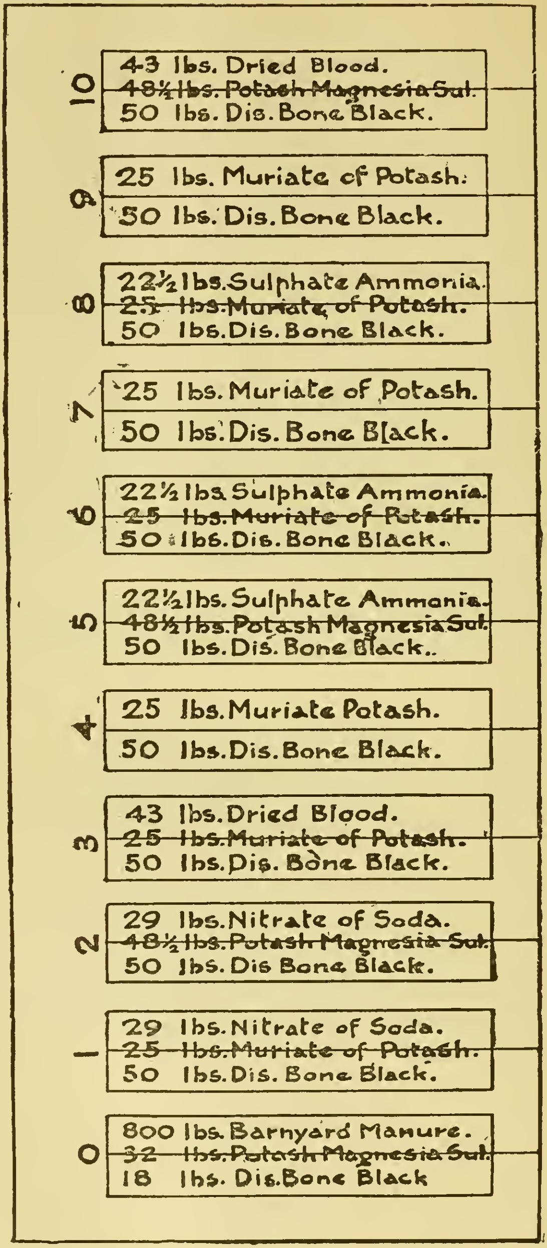
The best results in relation of total yield to yield of grain were obtained in the case of those plats receiving organic nitrogen (dried blood and barn-yard manure), or nitrogen in the form of nitrate of soda; while in the case of sulphate of ammonia the ratio of grain to straw was too wide to give the best satisfaction.

The total yield of crop on the plats receiving no nitrogen addition, as compared with those receiving a nitrogen supply, was: —

With oats in 1890, one-fifth to one-sixth less;
With rye in 1891, one-fifth to one-sixth less;
With soja bean in 1892, one-third to one-fourth less;
With oats in 1893, one-seventh to one-eighth less.

From this it will appear that the introduction of a leguminous crop into our rotation has somewhat reduced the difference in yield between the plats receiving no nitrogen and those receiving it, yet has not entirely obliterated it.

These experiments will be continued another year, with some modifications.



Field "A," 1893.

SCALE, 4 RODS TO 1 INCH.

## 2. FIELD EXPERIMENTS WITH SEVERAL PROMINENT VARIETIES OF GRASSES AND OF POTATOES.

### *Field B.*

This field occupies an area of one and seven-tenths acres, and runs from north to south, nearly on a level. The soil consists of a somewhat sandy loam of several feet in depth. The systematic treatment of the area was inaugurated in 1884, when the present subdivision into eleven plats was first introduced. The plats are 175 feet long and 33 feet wide (5,775 square feet, or two-fifteenths of an acre), of a uniform shape, running from east to west, with a space of five feet between adjoining plats. The numbering begins at the north end with 11, and closes at the south end with 21. From 1884 to 1889 every alternate plat received annually the same kind and the same amount of fertilizer, — 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre.

From 1889 to the close of the season of 1892 all plats were treated alike, as far as the system of cultivation and of manuring is concerned. The previously stated unmanured plats (12, 14, 16, 18 and 20) received from 1890, like the remaining plats (11, 13, 15, 17, 19 and 21), as manure annually at the rate of 600 pounds of fine-ground bone and 200 pounds of muriate of potash, applied broadcast either as a top dressing or thoroughly ploughed under, as circumstances admitted.

For details regarding the work carried on upon Field B previous to 1892, see tenth annual report.

The character of the crops raised during 1892 may be noticed from the subsequent tabular statement: —

*Crops raised in 1892.*

| PLATS. | 1892. |
|---|---|
| Plat 11, . | Kentucky blue-grass, sown Sept. 24, 1889. |
| Plat 12, . | Kentucky blue-grass and red top, sown Sept. 18, 1891. |
| Plat 13, | English rye-grass and Italian rye-grass, sown Sept. 29, 1890. |
| Plat 14, . | English rye-grass and red top, sown Sept. 29, 1890. |
| Plat 15, . | Herds grass and red top, sown April 23, 1891. |
| Plat 16, . | Italian rye-grass and red top, sown April 23, 1891 |
| Plat 17, . | Meadow fescue, sown Sept. 25, 1887. |
| Plat 18, . | Meadow fescue, sown Sept. 29, 1890. |
| Plat 19, . | Herds grass, sown Sept. 25, 1889. |
| Plat 20, . | Herds grass and red top, sown Sept. 29, 1890. |
| Plat 21, . | Meadow fescue and herds grass, sown Sept. 18, 1891. |

| AREA OF EACH PLAT, TWO-FIFTEENTHS ACRE. | Yield of Hay, First and Second Cut (Pounds). | Rate per Acre (Pounds). |
|---|---|---|
| Plat 11, sown Sept. 24, 1889, . . . . | 335 | 2,513 |
| Plat 12, sown Sept. 18, 1891, . . . . | 365 | 2,737 |
| Plat 13, sown Sept. 29, 1890, . . . . | 255 | 1,913 |
| Plat 14, sown Sept. 29, 1890, . . . . | 225 | 1,688 |
| Plat 15, sown April 23, 1891, . . . . | 565 | 4,238 |
| Plat 16, sown April 23, 1891, . . . . | 565 | 4,238 |
| Plat 17, sown Sept. 25, 1887, . . . . | 475 | 3,563 |
| Plat 18, sown Sept. 29, 1890, . . . . | 490 | 3,675 |
| Plat 19, sown Sept. 25, 1889, . . . . | 610 | 4,575 |
| Plat 20, sown Sept. 29, 1890, . . . . | 285 | 2,138 |
| Plat 21, sown Sept. 18, 1891, . . . . | 355 | 2,663 |
| Total, . . . . . . . . | 4,525 | |

At the close of the season (1892) it was decided to raise hereafter other crops than grasses upon plats 11, 13, 14, 15, 16 and 20. For this reason they were ploughed after the rowen had been secured, while plats 12, 17, 18, 19 and 21 remained in grass for another season.

*1893.* — Plats 11, 13, 14, 15, 16 and 20, which had been used for several preceding years for the production of grasses, were at an early date prepared to serve for experiments with several prominent varieties of potatoes. They were ploughed in August, 1892, and were again ploughed for the final preparation April 25, 1893.

It was proposed to compare the yield, as far as quantity and quality are concerned, under otherwise corresponding circumstances. Three varieties of potatoes, Beauty of Hebron, Clark's, New Queen, were chosen for the trial. The seed potatoes were obtained of J. J. H. Gregory & Son, Marblehead.

Two plats, 15 and 16, were assigned for the cultivation of Beauty of Hebron; two, 13 and 14, for that of New Queen; and two, 11 and 20, for that of Clark's variety.

One plat in each case received its potash supply in form of muriate of potash (plats 11, 13 and 15), and one in each case in that of high-grade sulphate of potash.

The actual amount of potassium oxide used in all cases remained the same.

*Statement of Fertilizers used (Pounds).*

| | | Per Plat. | Per Acre. |
|---|---|---|---|
| Plats 11, 13, 15, | Muriate of potash, | 54 | 400 |
| | Bone, | 80 | 600 |
| Plats 14, 16, 20, | Sulphate of potash (high grade), | 54 | 400 |
| | Bone, | 80 | 600 |

*Composition of Fertilizers used.*

| | Nitrogen. | Potash. | Phosphoric Acid. |
|---|---|---|---|
| Fine-ground bone, | 4.02 | – | 22.96 |
| Sulphate of potash, | – | 50.20 | – |
| Muriate of potash, | – | 46.00 | – |

*Market Cost of Fertilizers.*

| | Per Plat. | Per Acre. |
|---|---|---|
| Plats 11, 13, 15, | $2 39 | $17 93 |
| Plats 14, 16, 20, | 2 66 | 19 95 |

The final mechanical preparation of the different plats was the same in all cases. The fertilizer was applied broadcast, and subsequently thoroughly harrowed in before planting. The potatoes were planted May 10 on all plats at the rate of nineteen bushels per acre, or two and one-half bushels potatoes per plat. Potatoes used were either whole ones of medium size, or when larger were cut in pieces of sizes corresponding to the former. Plats 11 and 20 were planted with Clark's variety; plats 13 and 14 were planted with New Queen variety; plats 15 and 16 were planted with Beauty of Hebron variety.

The crop began to break ground May 26, and was subsequently cultivated and hoed June 5 and June 20. The potatoes were in bloom June 24, and the tops began to die August 14. The crop was harvested August 23 and 24.

The potatoes were in all cases of a superior appearance; only one-eighth to one-ninth of the entire crop was not marketable as a first-class article, on account of small size.

### YIELD OF CROP.

*A. Potash applied in the Form of Muriate.*

*Yield of Potatoes in Pounds.*

| VARIETY. | AMOUNT PER PLAT. | | | RATE PER ACRE. | | |
|---|---|---|---|---|---|---|
| | Marketable. | Small. | Total. | Marketable. | Small. | Total. |
| Plat 11, Clark's, . . | 1,450 | 225 | 1,675 | 10,875 | 1,688 | 12,563 |
| Plat 13, New Queen, . . | 1,620 | 240 | 1,860 | 12,150 | 1,800 | 13,950 |
| Plat 15, Beauty of Hebron, | 2,160 | 190 | 2,350 | 16,200 | 1,425 | 17,625 |

*Yield of Potatoes in Bushels (60 Pounds per Bushel).*

| | | | | | | |
|---|---|---|---|---|---|---|
| Plat 11, Clark's, . . | – | – | – | 181 | 28 | 209 |
| Plat 13, New Queen, . . | – | – | – | 203 | 30 | 233 |
| Plat 15, Beauty of Hebron, | – | – | – | 270 | 24 | 294 |

### YIELD OF CROP — *Concluded.*

### *B. Potash applied in the Form of High-grade Sulphate.*

*Yield of Potatoes in Pounds.*

| VARIETY. | AMOUNT PER PLAT. | | | RATE PER ACRE. | | |
|---|---|---|---|---|---|---|
| | Market-able. | Small. | Total. | Market-able. | Small. | Total. |
| Plat 20, Clark's, . . | 1,540 | 230 | 1,770 | 11,550 | 1,725 | 13,275 |
| Plat 14, New Queen, . . | 1,860 | 190 | 2,050 | 13,950 | 1,425 | 15,375 |
| Plat 16, Beauty of Hebron, | 2,190 | 240 | 2,430 | 16,425 | 1,800 | 18,225 |

*Yield of Potatoes in Bushels (60 Pounds per Bushel).*

| | | | | | | |
|---|---|---|---|---|---|---|
| Plat 20, Clark's, . . | – | – | – | 193 | 29 | 222 |
| Plat 14, New Queen, . . | – | – | – | 233 | 24 | 257 |
| Plat 16, Beauty of Hebron, | – | – | – | 274 | 30 | 304 |

An examination of the above tabular statement of the yield of the different varieties of potatoes on trial reveals the following facts: —

1. The yield of potatoes is in every instance larger in case sulphate of potash has furnished the potash of the fertilizer used, than where muriate of potash has served for that purpose.

2. The yield of the three varieties of potatoes on trial, although raised under a corresponding system of cultivation and of manuring, differs seriously. Beauty of Hebron produces nearly one-sixth more in weight than the New Queen variety, and one-third more than the Clark variety.

Plats 12, 17, 18, 19 and 21, which remained in grass in previous years, received as top-dressing, muriate of potash, 200 pounds, and ground bone, 600 pounds, per acre, at an early date in the spring, 1893. The grass was cut June 27 and 28. As the weeds began to infest the plats, the experiment of studying a variety of grasses was closed, and the sod turned under during the month of August. Dry lands do not favor for any length of time an economical and clean cultivation of the majority of our best grasses.

*Yield of First Cut of Grass, May (1893).*

| | |
|---|---|
| Plat 12, Kentucky blue-grass, . . . . . | sown Sept. 24, 1889. |
| Plat 17, Meadow fescue, . . . . . . . | sown Sept. 25, 1887. |
| Plat 18, Meadow fescue, . . . . . . . | sown Sept. 29, 1890. |
| Plat 19, Herds grass, . . . . . . . | sown Sept. 25, 1889. |
| Plat 21, Meadow fescue and herds grass, . . | sown Sept. 18, 1891. |

| | Yield per Plat (Pounds). | Rate per Acre (Pounds). |
|---|---|---|
| Plat 12, . . . . . . . . | 280 | 2,100 |
| Plat 17, . . . . . . . . | 280 | 2,100 |
| Plat 18, . . . . . . . . | 240 | 1,800 |
| Plat 19, . . . . . . . . | 430 | 3,225 |
| Plat 21, . . . . . . . . | 410 | 3,075 |

*Value of Grass Fertilizer.*

| | Per Plat. | Per Acre. |
|---|---|---|
| Plats 12, 17, 18, 19, 21, . . . . . | $2 39 | $17 93 |

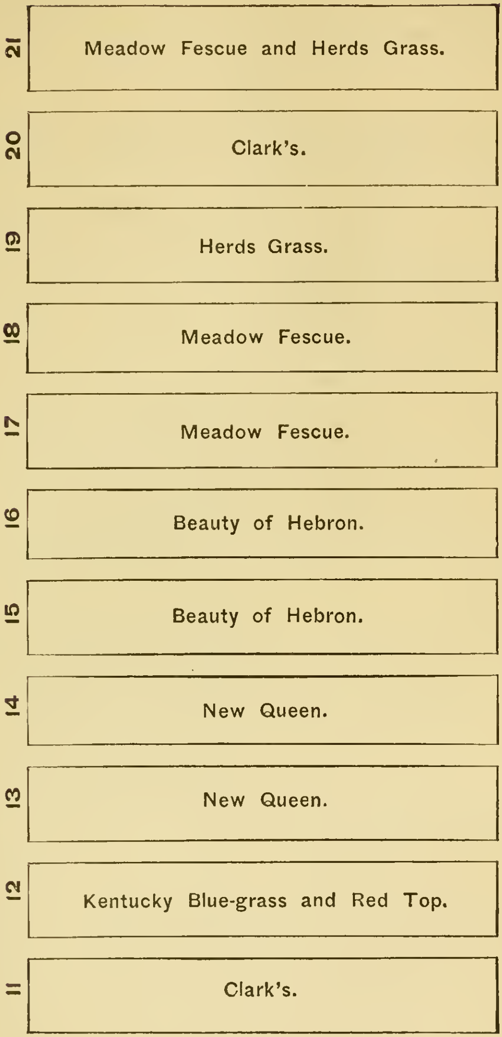
Some of our observations with grasses upon Field B deserve serious consideration of farmers in our section of the country: —

1. Italian rye grass is less liable to be winter-killed with us than English rye grass.

2. Meadow fescue furnishes a valuable grass, as far as a continuation of a healthy growth during a series of years is concerned, and excels in that respect the herds grass.

3. Grass mixtures as a rule yield larger crops than the same varieties when cultivated by themselves.

Field "B," 1893.



Scale, 4 rods to 1 inch.

## 3. FIELD EXPERIMENTS TO ASCERTAIN THE INFLUENCE OF DIFFERENT MIXTURES OF COMMERCIAL FERTILIZERS ON THE YIELD AND GENERAL CHARACTER OF SEVERAL PROMINENT GARDEN CROPS.

### *Field C.*

The area devoted to the above-stated experiment is 189 feet long and 164 feet wide; it is subdivided into six plats of uniform size (88 by 62 feet, or about one-eighth of an acre each). The plats are separated from each other and from the adjoining cultivated fields by a space of five feet of unmanured and unseeded yet cultivated land. They are arranged in two parallel rows, running from west to east. Nos. 1, 2 and 3 are along the north side of the field, beginning with No. 1 at its west end, while plats Nos. 4, 5 and 6 are located along its south side, beginning with Plat 4 on the west end. The soil is several feet deep, and consists of a light, somewhat gravelly loam, and was in a fair state of productiveness when assigned for the experiment here under consideration.

The entire field occupied by the experiment is nearly on a level. Its past history (since 1885), as far as mode of cultivation and manuring is concerned, is well known. Ground bone and muriate of potash, 600 pounds of the former and 200 pounds of the latter per acre, have been used for more than six years preceding 1891 as general fertilizer. No stable manure of any description has been applied to the field for seven years preceding. General field crops, as grain crops, leguminous plants, potatoes, etc., have been raised upon the grounds in suitable rotation during that period.

The observation with raising garden crops, by the aid of different mixtures of commercial manurial substances here under special consideration, began upon plats Nos. 4, 5 and 6 during the spring of 1891, and upon plats 1, 2 and 3 during that of 1892. The difference of the fertilizers applied consisted in the circumstance that different forms of nitrogen and potash were used for their preparation. All plats received essentially the same quantity of nitrogen, potash and phosphoric acid, and every one of them received its phosphoric acid addition in the same form, namely, dissolved bone-black. Some plats received their nitrogen supply in the form of organic animal matter, dried blood; others received their nitrogen in the form of sodium nitrate, Chili saltpetre; others in the form of ammonium sulphate. Some plats received their potash in the form of muriate of potash and others in the form of the highest grade of potassium sulphate (in our market 95 per cent.). The subsequent tabular statement shows the quantities of the manurial substances applied to the different plats: —

| Plats. | Annual Supply of Manurial Substances. | Pounds. |
|---|---|---|
| Plat 1, | Sulphate of ammonia, | 38 |
| | Muriate of potash, | 30 |
| | Dissolved bone-black, | 40 |
| Plat 2, | Nitrate of soda, | 47 |
| | Muriate of potash, | 30 |
| | Dissolved bone-black, | 40 |
| Plat 3, | Dried blood, | 75 |
| | Muriate of potash, | 30 |
| | Dissolved bone-black, | 40 |
| Plat 4, | Sulphate of ammonia, | 38 |
| | Sulphate of potash, | 30 |
| | Dissolved bone-black, | 40 |
| Plat 5, | Nitrate of soda, | 47 |
| | Sulphate of potash, | 30 |
| | Dissolved bone-black, | 40 |
| Plat 6, | Dried blood, | 75 |
| | Sulphate of potash, | 30 |
| | Dissolved bone-black, | 40 |

This proportion corresponds per acre to: —

| | Pounds. |
|---|---|
| Phosphoric acid (available), | 50.4 |
| Nitrogen, | 60.0 |
| Potassium oxide, | 120.0 |

Beets, cabbages, celery, lettuce, spinach, tomatoes and potatoes have been raised upon the field. One or more of noted varieties of each, as specified in our previous annual reports for 1891 and 1892, have thus far been tried. The field results of 1891 and 1892 have been published without comment, to enable us to accumulate more facts for the support of our conclusions. Upon a few subsequent pages will be found a description of the management of the experiments during the season of 1893, accompanied by a brief compilation and discussion of all the results thus far obtained.

The entire field was ploughed April 26, and the fertilizer mixtures given in the previous tabular statement were applied broadcast to the plats. The soil was subsequently harrowed and pulverized. All the crops were sown or planted as circumstances advised in rows two and one-half feet apart. Each of the different crops was sown or planted on the same day in all cases. Celery, cabbages, lettuce and tomatoes were raised in hot-beds, and afterwards transplanted to the different plats; while with spinach, beets and potatoes the seed was sown directly upon the plats.

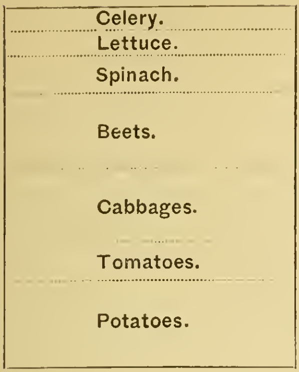
The following order in arranging the different crops was adopted, beginning in each plat at its western end: —

Two rows of spinach, variety New Zealand.
One row of celery, variety Dwarf Golden Heart.
One row of lettuce, variety Hanson.
One row of red cabbage, variety Red Dutch.
Two rows of beets, variety Edmund's Blood Turnip.
Five rows of potatoes, variety Beauty of Hebron.
Two rows of beets, variety Edmund's Blood Turnip.
Three rows of cabbages, variety Fottler's.
Two rows of tomatoes, variety Essex Hybrid.

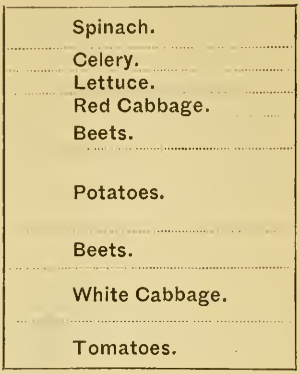
The order of arrangement of the different crops within each plat was the same in all of them for the same year. They occupied, however, a different position relative to each other in successive years, to introduce, as far as practicable, a system of rotation of crops.

Order of arrangement of crops in plats: —

1892.



1893.



A computation of the results of a chemical analysis of twenty prominent garden crops shows the following average relative proportion of the three above-stated essential ingredients of plant food: —

| | |
|---|---|
| Nitrogen, | 2.2 |
| Potassium oxide, | 2.0 |
| Phosphoric acid, | 1.0 |

One thousand pounds of green garden vegetables contain, on the above-stated basis of relative proportion of essential constituents of plant food: —

4.1 pounds of nitrogen.
3.9 pounds of potassium oxide.
1.9 pounds of phosphoric acid.

The weights and particular stage of growth of the vegetables when harvested control under otherwise corresponding conditions the actual consumption of each of these articles of plant food. Our information regarding these points is still too fragmentary to enable a more detailed statement here beyond relative proportions. It must suffice for the present to call attention to the fact that a liberal manuring within reasonable limits pays, as a rule, better than a scanty one.

The various mixtures of fertilizers used by us in the experiments under discussion provide by actual supply for one-half of the available nitrogen actually called for to meet the demand as above pointed out. A liberal cultivation of peas and beans cannot fail to benefit the nitrogen resources of the soil.

Potatoes were planted May 10; spinach and beets were sown May 15; lettuce and cabbage plants were set out May 15; tomatoes were set out May 29; celery plants were set out June 20. The seeds in every case were taken from the same lot; the young plants were raised under corresponding conditions in the same hot-bed, and a corresponding number transplanted in each plat. All plats were kept clean from weeds and treated in a like manner during the season. The crops were harvested whenever fit for the market. The subsequent tabular statements of the yield of the crops show the date of maturity and the quantity obtained at different dates: —

*Yield of Spinach (Variety New Zealand).*

| Plats. | Pounds. |
|---|---|
| Plat 1 (two rows), | 167½ |
| Plat 2 (two rows), | 182 |
| Plat 3 (two rows), | 180½ |
| Plat 4 (two rows), | 57 |
| Plat 5 (two rows), | 210 |
| Plat 6 (two rows), | 198½ |

The seed was sown May 10; the crop was harvested July 12. The low yield of Plat 4 was due to poor germination of the seed.

*Yield of Beets (Variety Edmund's Blood Turnip).*

| Plats. | Pounds. |
|---|---|
| Plat 1 (four rows), | 284½ |
| Plat 2 (four rows), | 382 |
| Plat 3 (four rows), | 241½ |
| Plat 4 (four rows), | 371½ |
| Plat 5 (four rows), | 468½ |
| Plat 6 (four rows), | 447 |

The seed was sown May 15, came up May 22, and the roots were harvested October 17.

*Yield of Red Cabbage (Variety Red Dutch).*

| Plats. | Perfect Heads. | Pounds. |
|---|---|---|
| Plat 1 (one row; thirty-five plants), | 29 | 266¼ |
| Plat 2 (one row; thirty-five plants), | 29 | 213½ |
| Plat 3 (one row; thirty-five plants), | 28 | 178½ |
| Plat 4 (one row; thirty-five plants), | 27 | 180½ |
| Plat 5 (one row; thirty-five plants), | 27 | 188½ |
| Plat 6 (one row; thirty-five plants), | 32 | 215½ |

The plants were set out May 15 and harvested October 2.

*Yield of White Cabbage (Fottler's).*

| Plats. | Perfect Heads. | Pounds. |
|---|---|---|
| Plat 1 (three rows; thirty-four plants each), | 77 | 605 |
| Plat 2 (three rows; thirty-four plants each), | 77 | 597¼ |
| Plat 3 (three rows; thirty-four plants each), | 87 | 600¾ |
| Plat 4 (three rows; thirty-four plants each), | 70 | 674¾ |
| Plat 5 (three rows; thirty-four plants each), | 87 | 711 |
| Plat 6 (three rows; thirty-four plants each), | 86 | 730¾ |

The plants were set out May 15; they were harvested September 1 to October 2.

*Yield of Potatoes (Variety Beauty of Hebron).*

| Plats. | Pounds. | | |
|---|---|---|---|
| | Marketable. | Small. | Total. |
| Plat 1 (five rows), . . . . | 314 | 86 | 400 |
| Plat 2 (five rows), . . . . | 458 | 62 | 520 |
| Plat 3 (five rows), . . . . | 309 | 81 | 390 |
| Plat 4 (five rows), . . . . | 455 | 70 | 525 |
| Plat 5 (five rows), . . . . | 462 | 58 | 520 |
| Plat 6 (five rows), . . . . | 475 | 105 | 580 |

The potatoes were planted May 10, one bushel of seed being used per plat; they were dug August 19.

*Yield of Celery (Variety Dwarf Golden Heart).*

| Plats. | Perfect Heads | Pounds. |
|---|---|---|
| Plat 1 (one row; eighty plants), . . . | * | * |
| Plat 2 (one row; eighty-four plants), . . | * | * |
| Plat 3 (one row; eighty-four plants), . . | * | * |
| Plat 4 (one row; eighty-four plants), . . | * | * |
| Plat 5 (one row; eighty-four plants), . . | * | * |
| Plat 6 (one row; eighty-four plants), . . | * | * |

* Practically a failure on account of the drought.

The plants were set out June 20.

*Yield of Lettuce (Variety Hanson).*

| Plats. | Perfect Heads. | Pounds. |
|---|---|---|
| Plat 1 (one row; seventy-five plants), . . | 65 | 37½ |
| Plat 2 (one row; seventy-five plants), . . | 67 | 40 |
| Plat 3 (one row; seventy-three plants), . . | 68 | 45 |
| Plat 4 (one row; seventy-seven plants), . . | 71 | 62½ |
| Plat 5 (one row; seventy-five plants), . . | 73 | 75 |
| Plat 6 (one row; seventy-five plants), . . | 67 | 52 |

The plants were set out May 15; they were harvested July 6.

*Yield of Tomatoes (Variety Essex Hybrid).*

| DATE OF HARVESTING. | PLATS. | | | | | |
|---|---|---|---|---|---|---|
| | **1.** | **2.** | **3.** | **4.** | **5.** | **6.** |
| | Pounds. | Pounds. | Pounds. | Pounds. | Pounds. | Pounds. |
| August 8 (matured), . . | 22 | 20 | 15½ | 12¼ | 9 | 15½ |
| August 11 (matured), . . | 25 | 18½ | 24½ | 24½ | 26½ | 18 |
| August 16 (matured), . . | 38 | 35 | 48 | 55¼ | 52 | 49 |
| August 21 (matured), . . | 36½ | 42½ | 25¼ | 49 | 48¼ | 63 |
| August 25 (matured), . . | 32½ | 46½ | 47 | 53 | 53½ | 65½ |
| August 30 (matured), . . | 45 | 80 | 73 | 72 | 100¾ | 57 |
| September 1 (matured), . | 16½ | 65½ | 61 | 86½ | 85½ | 32¾ |
| September 5 (matured), . | 19 | 47 | 77 | 95 | 112 | 60¼ |
| September 11 (matured), . | 26 | 83 | 89 | 62½ | 122½ | 39 |
| September 15 (matured), . | 19½ | 111 | 86½ | 71 | 92 | 19½ |
| September 20 (matured), . | 26½ | 111½ | 93¼ | 100½ | 154¾ | 35 |
| Total weight of matured tomatoes, . . . . | 306½ | 660½ | 640 | 681½ | 756¼ | 437½ |
| September 23 (green), . . | 56½ | 214 | 167¼ | 137 | 222½ | 81 |
| Total weight of tomatoes, both matured and green, | 363 | 874½ | 807¼ | 818½ | 978¾ | 515½ |

There were two rows in each plat, and from twenty-two to twenty-three plants in each row. The plants were set out from the hot-bed May 29; they came in bloom June 16, and began to form tomatoes June 29.

*Potatoes (Variety Beauty of Hebron).*

| PLATS. | POUNDS. | | |
|---|---|---|---|
| | **1891.** | **1892.** | **1893.** |
| Plat 1 (five rows), . . . . . | – | 585 | 400 |
| Plat 2 (five rows), . . . . . | – | 665 | 520 |
| Plat 3 (five rows), . . . . . | – | 545 | 390 |
| Plat 4 (five rows), . . . . . | 735 | 640 | 525 |
| Plat 5 (five rows), . . . . . | 780 | 740 | 520 |
| Plat 6 (five rows), . . . . . | – | 435 | 580 |

### *Tomatoes (Variety Essex Hybrid).*

| PLATS | POUNDS. | | |
|---|---|---|---|
| | 1891. | 1892. | 1893. |
| Plat 1 (two rows), | – | 464 | 339 |
| Plat 2 (two rows), | – | 572 | 874½ |
| Plat 3 (two rows), | – | 466 | 807 |
| Plat 4 (two rows), | 641 | 515 | 783 |
| Plat 5 (two rows), | 647 | 593 | 928½ |
| Plat 6 (two rows), | – | 332 | 515 |

### *Lettuce (Variety Hanson).*

| SEVENTY PLANTS. | 1892. | 1893. |
|---|---|---|
| Plat 1 (one row), | 41½ | 40½ |
| Plat 2 (one row), | 36 | 42 |
| Plat 3 (one row), | 43 | 46 |
| Plat 4 (one row), | 76 | 62 |
| Plat 5 (one row), | 60 | 70 |
| Plat 6 (one row), | 36 | 55 |

### *Cabbages (Variety Fottler's).*

| SIXTY-TWO PLANTS. | 1892. | 1893. |
|---|---|---|
| Plat 1 (two rows), | 534 | 490 |
| Plat 2 (two rows), | 762 | 484 |
| Plat 3 (two rows), | 576 | 428 |
| Plat 4 (two rows), | 458 | 595 |
| Plat 5 (two rows), | 674 | 508 |
| Plat 6 (two rows), | 586 | 527 |

*Spinach (Variety New Zealand).*

| Plats. | 1892. | 1893. |
|---|---|---|
| Plat 1 (two rows), . . . . . . | 192 | 167½ |
| Plat 2 (two rows), . . . . . . | 233 | 182 |
| Plat 3 (two rows), . . . . . . | 202 | 180½ |
| Plat 4 (two rows), . . . . . . | 230 | – |
| Plat 5 (two rows), . . . . . . | 232 | 210 |
| Plat 6 (two rows), . . . . . . | 134 | 198½ |

*Beets (Variety Edmund's Blood Turnip).*

| Plats. | 1892. | 1893. |
|---|---|---|
| Plat 1 (four rows), . . . . . . | 350 | 284½ |
| Plat 2 (four rows), . . . . . . | 345 | 382 |
| Plat 3 (four rows), . . . . . . | 515 | 241½ |
| Plat 4 (four rows), . . . . . . | 455 | 371½ |
| Plat 5 (four rows), . . . . . . | 509 | 468½ |
| Plat 6 (four rows), . . . . . . | 495 | 447 |

An examination of the preceding results shows the serious influence of the dry weather throughout a large part of the past season, as affecting the total yield of the different plats as compared with each other. Potatoes, cabbages, beets and spinach show a marked decrease in total yield over last year, while lettuce and tomatoes show a considerably larger yield. The relative yield of the plats for both seasons is only slightly affected.

### *Field C, Eastern Portion.*

The portion of Field C east of the plats is 183 by 131 feet, and contains .55 acre. The fertilizer applied consisted of 300 pounds of fine-ground bone and 100 pounds of muriate of potash, applied broadcast. On May 8 the field was sown to vetch and oats, 25 pounds of vetch and 2½ bushels of oats being used for seed. The crop made an even and rapid growth. About two-fifths of the crop was used for green fodder July 6 to 18. The remainder was cut as hay. The area cut for green fodder yielded 5,053 pounds, or 21,800 pounds per acre; that cut as hay weighed 1,750 pounds, or 5,469 pounds per acre. On July 28 the land was again ploughed. A fertilizer mixture, composed of 100 pounds of nitrate of potash and 300 pounds of ground bone, was applied broadcast and harrowed in. August 4 the field was sown to buckwheat; this came in bloom September 1. The crop began to be cut for green fodder when in full bloom, September 11, and the cutting was completed September 29. The yield of green fodder was 3,870 pounds, or 7,036 pounds of green fodder per acre.

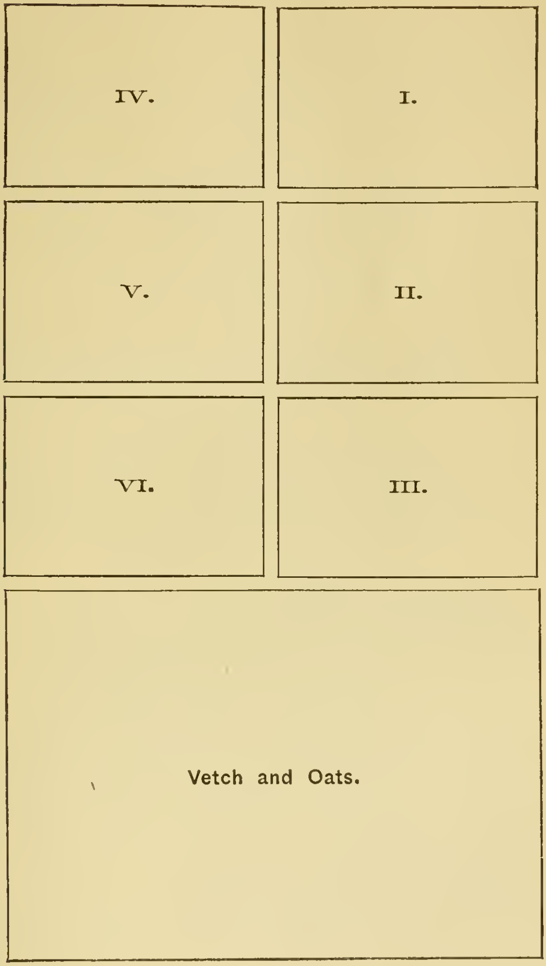
*Analysis of Vetch and Oats (Green).*

| | |
|---|---|
| Moisture at 100° C., | 79.16 |
| Dry matter, | 20.84 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 8.80 |
| " cellulose, | 30.34 |
| " fat, | 3.90 |
| " protein, | 13.27 |
| Nitrogen-free extract matter, | 43.69 |
| | 100.00 |

Field "C," 1893.



Scale, 4 rods to 1 inch.

## 4. Experiments with a Variety of New Forage Crops (1893).

### *Field D.*

This field has been used for the past two years for the raising of a variety of reputed annual and perennial fodder crops, in the majority of cases new to our section of the country, to study their adaptation to our climate and soil. Some of them have since been raised on a larger scale successfully and profitably for the support of our dairy stock.

The field is 328 feet long and 70 feet wide, covering an area of 22,960 square feet, or .527 acre. The land was ploughed April 24 and May 10. The fertilizer used consisted of a mixture of 600 pounds of ground bone and 200 pounds of muriate of potash, which was applied broadcast and harrowed in before seeding. The different crops were planted in rows two and one-half feet apart, and were kept free from weeds throughout the season. They were arranged in the field during the past season in the following order, beginning at the west end: —

White lupine (*Lupinus albus*).
Yellow lupine (*Lupinus lutens*).
Prickley comfrey (*Symphytum officinale*).
Forest pea or flat pea (*Lathyrus sylvestris*).
Late-maturing soja bean (*Soja hispida*).
Kidney vetch (*Anthyllis vulneraria*).
Early-maturing white soja bean (*Soja hispida*).
Sainfoin (*Onobrychis sativa*).
Early-maturing black soja bean (*Soja hispida*).
Cow-pea (*Dolichos sinensis*).
Serradella (*Ornithopus sativus*).
Spring vetch (*Vicia sativa*).
Bokhara clover (*Melilotus alba*).
Horse bean (*Vicia faba*).
Kaffir corn.
Common buckwheat (*Fagopyrum esculentum*).
Japanese buckwheat (*Fagopyrum esculentum*).
Silver-hull buckwheat (*Fagopyrum esculentum*).
Summer rape (*Brassica Napus*).
Carrots (*Daucus carota*).

White lupine (*Lupinus alba*), four rows. The seed was sown May 19. The young plants broke ground May 29;

they were considerably affected by the drought of July and August. The plants proved to be of a late variety, blossoming the latter part of September. The seed was bought of J. M. Thorburn, New York City, at eleven cents per pound.

Yellow lupine (*Lupinus lutens*), four rows. The seed was sown May 19 and came up May 29. The plants began to blossom July 29, pods commenced forming August 5, and ripened seed throughout the month of September. Large, well-formed tubercles were found on the roots of this, as well as on those of the preceding variety.

Both varieties of lupine deserve a high recommendation for green manuring, having served us well for that purpose.

Prickley comfrey (*Symphytum officinale*), one row. The roots remained in the ground from last year, and wintered well during the winter of 1892–93. The plants started into growth early in the spring, and blossomed June 13; July 24 they were cut. The plants were again cut early in the fall. Both cuttings showed a liberal, vigorous growth. This fodder plant offers but little inducement for home cultivation when compared with many of our annual leguminous plants.

Forest pea or flat pea (*Lathyrus sylvestris*), three rows. The roots remained in the ground from last year; they were partially winter-killed. The crop blossomed June 24 and was cut July 27, at which time the growth was large and rank. A second growth was cut during the fall. Our results thus far are but little encouraging.

Late-maturing soja bean (*Soja hispida*), two rows. The seed was sown May 19, the young plants appearing above the ground May 29. They made a vigorous and leafy growth, blossoming September 15. This variety is apparently of much less feeding value than the earlier blooming varieties. The seed was obtained of J. M. Thorburn of New York City, at eight cents per pound.

Kidney vetch (*Anthyllis vulneraria*), four rows. The roots remained in the ground from last year, and wintered very well. The plants blossomed for the first time since seeding June 13; they were cut July 24. No second cut was obtained. It is a very attractive plant when in bloom. Seed was bought of D. Landreth & Sons, Philadelphia, Pa.

Early-maturing white soja bean (*Soja hispida*), ten rows.

The seed was sown May 19 and came up May 29. The plants began to blossom July 17; they were cut August 19. The seed was of our own raising. This variety has served us well for several years as hay and as ensilage (see previous reports).

Sainfoin (*Onobrychis sativa*), five rows. The crop wintered well from last year. The plants began to blossom June 5 and were cut July 27. A second growth was produced. The seed was bought of Henry Nungesser, New York City, at six cents per pound.

Early-maturing black soja bean (*Soja hispida*), five rows. The seed was sown May 19 and the young plants broke ground May 29. They came into bloom July 17 and were cut August 19. The only marked difference between the black and the white varieties consists in the color of the seeds and of more foliaceous growth in the case of the black variety. It is a valuable fodder plant and stands our climate well. The seed used was of our own raising.

Cow-pea (*Dolichos sinensis*), five rows. The seed was sown May 19, the young plants appearing above ground May 26. August 26 the plants blossomed and were cut for fodder. Most varieties of this plant do not produce ripe seed with us. The seed was obtained of D. Landreth & Sons, Philadelphia, Pa.

Serradella (*Ornithopus sativus*), five rows. The seed was sown May 19 and came up May 29; blossoms appeared July 11 and the crop was cut for fodder August 14. The growth was very rank and heavy. The crop has supplied us for years with a good green fodder. The seed was obtained of Henry Nungesser, New York City, at eight cents per pound.

Spring vetch (*Vicia sativa*), five rows. The seed was sown May 19, the plants appearing May 26 and beginning to blossom July 11. August 4 the growth was cut for fodder. Vetch with oats has furnished us for several years an excellent material for green fodder and hay. The seed was obtained of Henry Nungesser, New York City, at eight cents per pound.

Bokhara clover (*Melilotus alba*), five rows. The seed was sown May 19. The plants appeared above ground May 26, and were cut August 12, at which time there were no signs of blooming. There was a small second growth. The plant with us is apt to grow rank and too woody to furnish an acceptable fodder article for any length of time. The seed was bought of Henry Nungesser, New York City, at twenty cents per pound.

Horse bean (*Vicia faba*), five rows. The seed was sown May 19 and came up May 29. The plants began to bloom July 11. During the summer a blight attacked some of the leaves, turning them black. The plant furnishes a good green fodder when raised in connection with oats or barley and vetch. The seeds are very nutritious. The plants were cut September 28. The seed was obtained of J. M. Thorburn & Sons, New York, N. Y., at nine cents per pound.

Kaffir corn, one row. The seed was sent on for trial from Lawrence, Kan. It was planted May 19 and began to come up May 30; August 26 the plants began to head out. They reached a height of five feet, and were characterized by slender but very leafy stems. No great agricultural merit could be obtained in our section of the country, as the plant does not mature.

Common buckwheat (*Fagopyrum esculentum*), five rows. The seed was sown May 19. The plants broke ground May 27 and came in bloom June 24. This buckwheat made a smaller growth than either of the others. It was cut for fodder July 31. We have used common buckwheat with good results as second crop after vetch and oats or summer grain, to serve as green fodder for cattle during the latter part of the season.

Japanese buckwheat (*Fagopyrum esculentum*), five rows. The seed was sown May 19 and came up May 25. The plants came in blossom June 24. The growth was very heavy, the leaf development being greater than in the case of either of the two other varieties of buckwheat. The plants were cut for fodder, when beginning to form seed, on August 2. This variety deserves the serious attention of farmers as a substitute for our common buckwheat. The seed was obtained of J. M. Thorburn, New York, N. Y., at six cents per pound.

Silver-hull buckwheat (*Fagopyrum esculentum*), five rows. The seed was sown May 19. The plants broke ground May 27 and came into bloom June 24. July 29 they were cut for fodder. The seed was obtained of J. M. Thorburn, New York City, at six and one-fourth cents per pound.

Summer rape (*Brassica Napus*), five rows. The seed was sown May 19 and came up May 25. The plants were cut for fodder August 7, at which date they showed no signs of blooming. A second growth was cut early in the fall. Both cuttings showed a healthy and abundant growth. The seed was obtained of D. Landreth & Sons, Philadelphia, Pa.

Carrots (*Daucus carota*). The seed was sown June 1, appearing above ground June 10. The plat (.155 acres) was weeded and hoed July 10. The crop was harvested November 2. Yield, 5,540 pounds, or 13–14 tons per acre.

### *Analyses of Crops raised upon Field D (1893).*

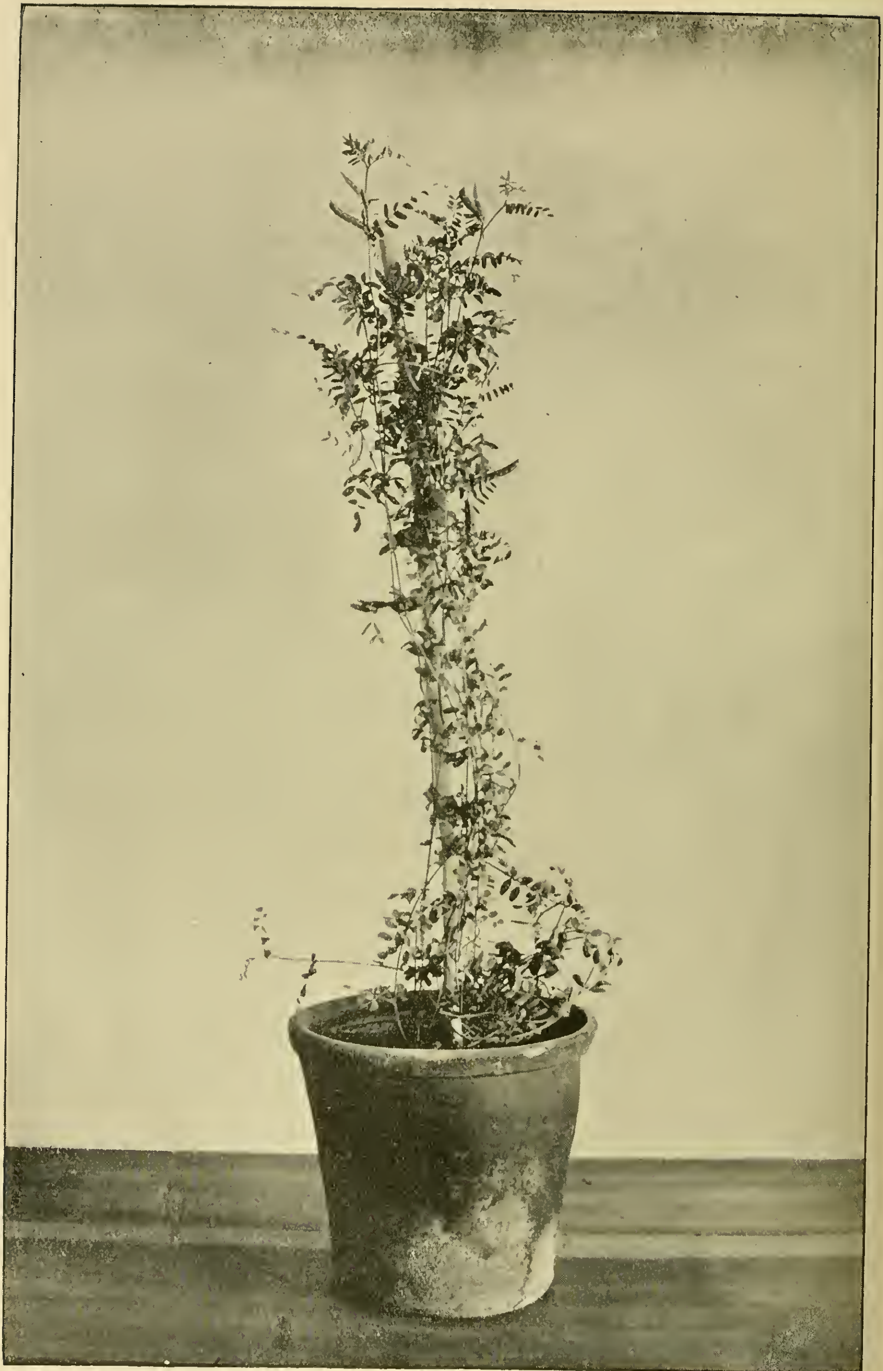
[I., common buckwheat (*Fagopyrum esculentum*): dried; cut when in bloom II, silver-hull buckwheat (*Fagopyrum esculentum*): dried; in bloom. III, Japanese buckwheat (*Fagopyrum esculentum*): dried; in bloom. IV., summer rape (*Brassica Napus*): dried; cut before blooming. V., prickley comfrey (*Symphytum officinale*): second growth]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 8.50 | 8.91 | 5.71 | 11.13 | 86.79 |
| Dry matter, | 91.50 | 91.09 | 94.29 | 88.87 | 13.21 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 14.63 | 10.17 | 12.36 | 18.25 | 21.12 |
| " cellulose, | 19.35 | 27.07 | 36.02 | 18.15 | 11.03 |
| " fat, | 3.04 | 2.55 | 2.22 | 3.79 | 2.06 |
| " protein, | 17.90 | 12.22 | 10.80 | 14.43 | 17.49 |
| Nitrogen-free extract matter, | 45.08 | 47.99 | 38.60 | 45.38 | 48.00 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

*Fertilizing Constituents.*

| | I. | II. | III. | IV. | V. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 8.500 | 8.910 | 5.720 | 11.130 | 86.790 |
| Dry matter contains: — | | | | | |
| Nitrogen, | 2.866 | 1.954 | 1.727 | 2.310 | 2.800 |
| Potassium oxide, | 3.504 | 2.612 | 3.521 | 5.254 | 5.745 |
| Calcium oxide, | –* | 2.514 | 3.625 | 4.153 | 2.263 |
| Magnesium oxide, | –* | .577 | .446 | .587 | .310 |
| Phosphoric acid, | .547 | .944 | .903 | .643 | .870 |
| Insoluble matter, | –* | .507 | .400 | .781 | –* |

* Not determined.

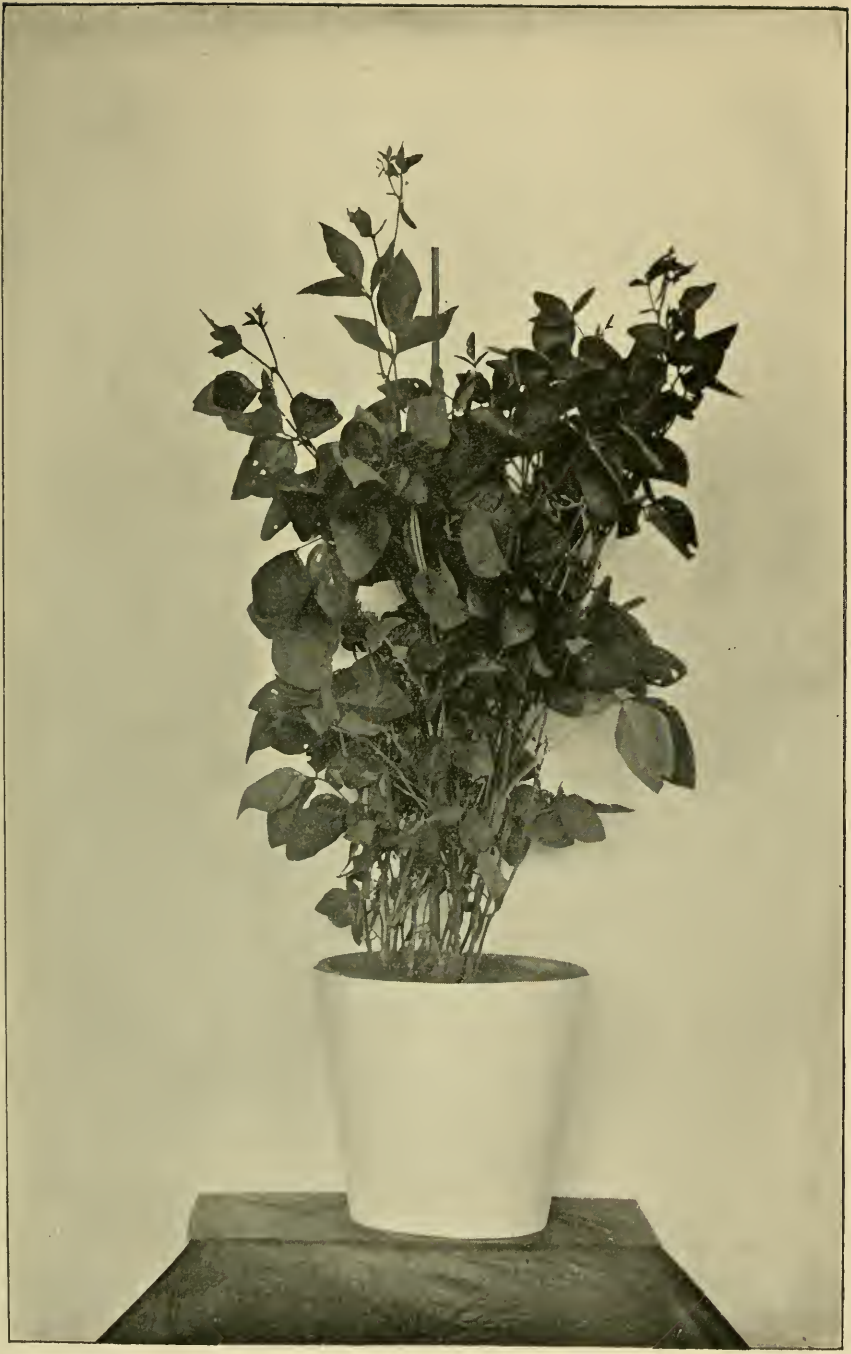


Spring Vetch (*Vicia sativa*).

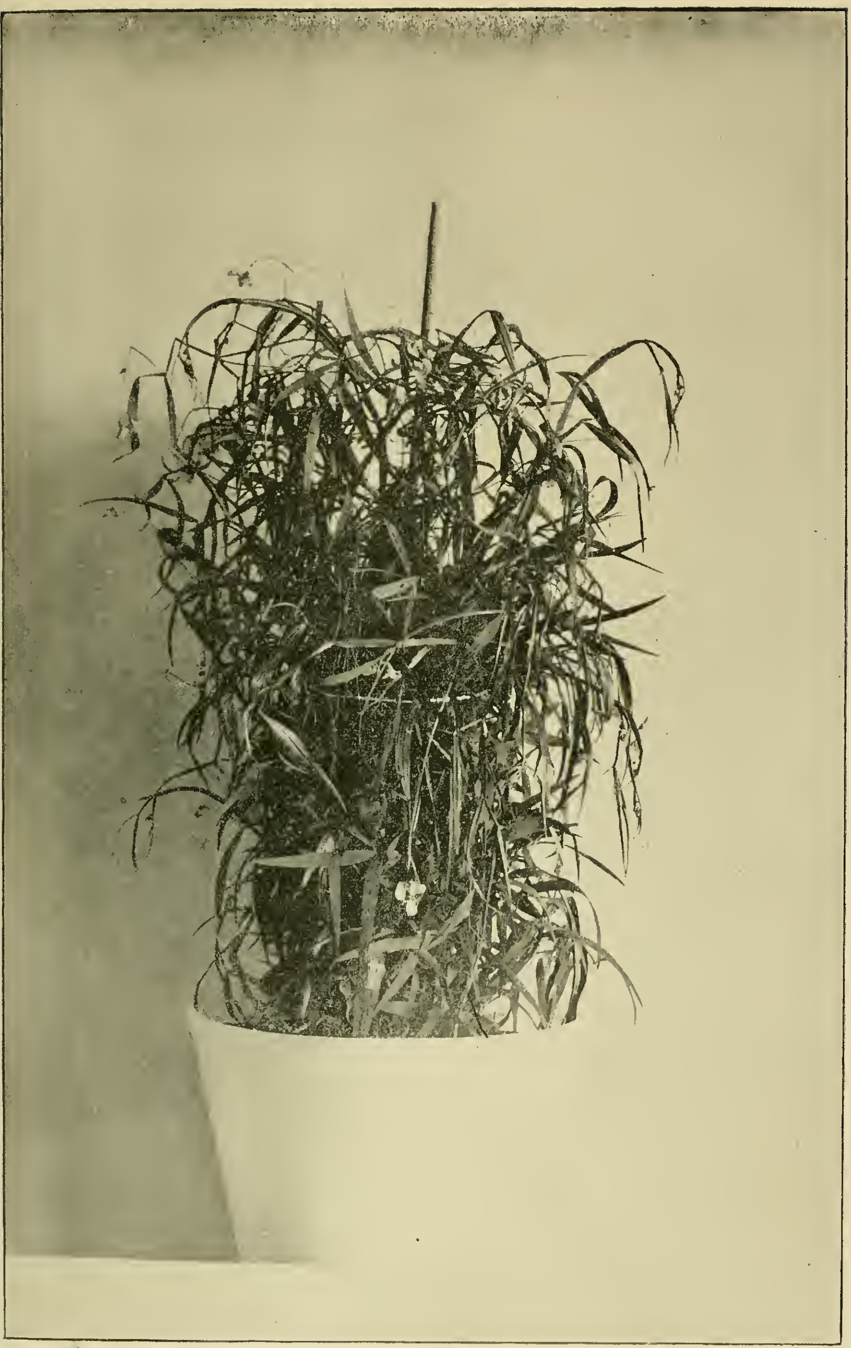
July, 1891. Pods forming.

Kidney Vetch (*Anthyllis vulneraria*).

August, 1893. In bloom.



Early-maturing Soja Bean (*Soja hispida*).
September, 1893. With pods formed.



Flat Pea (*Lathyrus sylvestris*).

August, 1893. In bloom.

### *Analyses of Crops raised upon Field D (1893)* — Continued.

[I., yellow lupine (*Lupinus lutens*) : in bloom. II., white lupine (*Lupinus albus*) : in bloom. III., sainfoin (*Onobrychis sativus*) : dried ; in bloom. IV., Bokhara clover (*Melilotus alba*) : dried ; in bloom. V., serradella (*Ornithopus sativa*) : green ; in bloom. VI., kidney vetch (*Anthyllis vulneraria*) : second growth ; in bloom.]

| | PER CENT. | | | | | |
|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. | VI. |
| Moisture at 100° C., . | 86.05 | 85.35 | 12.17 | 7.43 | 82.41 | 80.85 |
| Dry matter, . . | 13.95 | 14.65 | 87.83 | 92.57 | 17.59 | 19.15 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | | |
| Crude ash, . . . | 11.14 | 5.03 | 8.54 | 7.66 | 10.99 | 13.28 |
| " cellulose, . | 27.10 | 31.18 | 26.95 | 30.57 | 30.08 | 14.94 |
| " fat, . . . | 1.87 | 2.41 | 4.49 | 3.32 | 2.41 | 3.51 |
| " protein, . . | 17.84 | 18.71 | 17.70 | 13.37 | 15.01 | 18.43 |
| Nitrogen-free extract matter, . . . | 42.05 | 42.67 | 42.27 | 45.08 | 41.13 | 49.84 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

*Fertilizing Constituents.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Moisture at 100° C., . | 85.05 | 85.350 | 12.170 | 7.430 | 82.410 | 80.850 |
| Dry matter contains : — | | | | | | |
| Nitrogen, . . | 2.662 | 2.993 | 2.880 | 2.133 | 2.632 | 2.939 |
| Potassium oxide, . | 2.949 | 1.730 | 2.299 | 1.979 | 2.414 | 1.754 |
| Calcium oxide, . | 1.926 | 3.070 | 1.320 | 1.927 | 2.636 | 4.736 |
| Magnesium oxide, | .328 | .730 | .489 | .374 | .384 | .287 |
| Phosphoric acid, . | .603 | .350 | .854 | .602 | .804 | .443 |
| Insoluble matter, . | 1.076 | .900 | .535 | .061 | .557 | .809 |

## *Analyses of Crops raised upon Field D (1893)* — Concluded.

[I., flat pea (*Lathyrus sylvestris*) : in bloom. II., flat pea (*Lathyrus sylvestris*) : second growth. III., common vetch (*Vicia sativa*) : in bloom. IV., horse bean (*Vicia faba*) : with pods forming. V., soja bean (*Soja hispida*) : with pods forming. VI., cow-pea (*Dolichos sinensis*) : with pods forming.

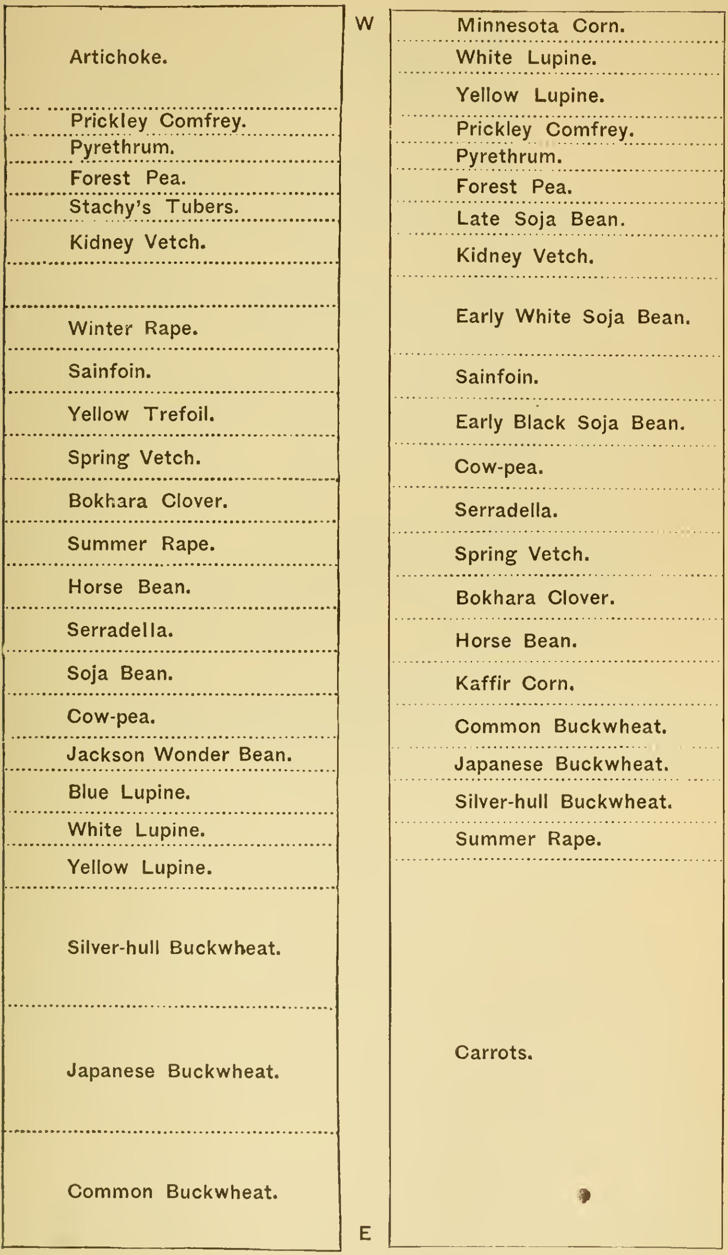
| | PER CENT. | | | | | |
|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. | VI. |
| Moisture at 100° C., . | 8.96 | 78.62 | 9.90 | 84.83 | 76.42 | 80.31 |
| Dry matter, . . | 91.10 | 21.38 | 91.10 | 15.17 | 23.58 | 19.69 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | | |
| Crude ash, . . . | 9.39 | 8.91 | 8.24 | 5.75 | 7.74 | 9.29 |
| " cellulose, . | 31.76 | 20.38 | 30.27 | 28.17 | 26.47 | 21.67 |
| " fat, . . . | 1.78 | 5.00 | 2.50 | 2.31 | 4.84 | 4.06 |
| " protein, . . | 24.04 | 30.65 | 15.09 | 16.68 | 16.45 | 17.05 |
| Nitrogen-free extract matter, . . . | 33.03 | 35.06 | 43.80 | 47.09 | 44.50 | 47.93 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

### *Fertilizing Constituents.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Moisture at 100° C., . | 8.96 | 78.62 | 9.90 | 84.83 | 76.42 | 80.31 |
| Dry matter contains : — | | | | | | |
| Nitrogen, . . | 3.846 | 4.904 | 2.414 | .675 | 2.476 | 1.796 |
| Potassium oxide, . | 2.572 | 2.100 | 3.010 | 1.370 | 1.151 | 1.042 |
| Calcium oxide, . | 1.791 | 1.412 | 1.860 | 1.370 | 2.945 | 2.964 |
| Magnesium oxide, | .498 | .411 | –* | .620 | 1.257 | .756 |
| Phosphoric acid, . | .900 | .655 | .810 | .330 | .711 | .579 |
| Insoluble matter, . | 2.011 | 1.155 | .560 | 2.040 | –* | .914 |

* Not determined.

## Field "D." — Arrangement of Crops raised.



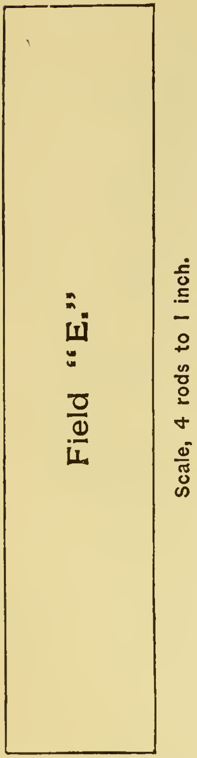
1892.

- Artichoke.
- Prickley Comfrey.
- Pyrethrum.
- Forest Pea.
- Stachy's Tubers.
- Kidney Vetch.
- Winter Rape.
- Sainfoin.
- Yellow Trefoil.
- Spring Vetch.
- Bokhara Clover.
- Summer Rape.
- Horse Bean.
- Serradella.
- Soja Bean.
- Cow-pea.
- Jackson Wonder Bean.
- Blue Lupine.
- White Lupine.
- Yellow Lupine.
- Silver-hull Buckwheat.
- Japanese Buckwheat.
- Common Buckwheat.

1893.

- Minnesota Corn.
- White Lupine.
- Yellow Lupine.
- Prickley Comfrey.
- Pyrethrum.
- Forest Pea.
- Late Soja Bean.
- Kidney Vetch.
- Early White Soja Bean.
- Sainfoin.
- Early Black Soja Bean.
- Cow-pea.
- Serradella.
- Spring Vetch.
- Bokhara Clover.
- Horse Bean.
- Kaffir Corn.
- Common Buckwheat.
- Japanese Buckwheat.
- Silver-hull Buckwheat.
- Summer Rape.
- Carrots.

Scale, 50 feet to 1 inch.



### *Field E (Rye).*

This field is 260 feet long and 48 feet wide, containing .286 acre. In September of 1892 the field was ploughed and the following fertilizer mixture applied: 200 pounds of fine-ground bone and 70 pounds of high-grade sulphate of potash. The field was then sown to rye and winter rape, two-thirds of a bushel of rye and ten pounds of rape being used for seed. Both the rye and the rape came up and made a fair fall growth. The rye wintered well, but the rape entirely winter-killed.* The rye headed out May 29 and was cut July 12.

*Yield of Rye.*

| | Pounds. |
|---|---|
| Grain, | 336 |
| Straw and chaff, | 1,243 |

*Rate per Acre.*

| | |
|---|---|
| Grain, | 1,175 |
| Straw and chaff, | 4,246 |

---

* Judging from the experiment, the seed sown proved to be summer rape instead of winter rape, as supposed.

## 5. Field Experiments with Different Commercial Phosphates to study the Economy of using the Cheaper Natural Phosphates or the More Costly Acidulated Phosphates.

### *Field F.*

The field selected for this purpose is 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella) followed each other in the order stated.

*1890.* — The field was subdivided into five plats, running from east to west, each twenty-one feet wide, with a space of eight feet between adjoining plats.

The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium oxide and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article, namely, phosphatic slag, Mona guano, Florida phosphate, South Carolina phosphate (floats) and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value in its particular kind of phosphate.

*Cost per Ton.*

| | |
|---|---|
| Phosphatic slag, | $15 00 |
| Mona guano (West Indies), | 15 00 |
| Florida rock phosphate, | 15 00 |
| South Carolina phosphate (floats), | 15 00 |
| Dissolved bone-black, | 25 00 |

*Analyses of Phosphates used.*

[I., phosphatic slag; II., Mona guano; III., Florida phosphate; IV., South Carolina phosphate; V., dissolved bone-black.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture, | 0.47 | 12.52 | 2.53 | 0.39 | 15.96 |
| Ash, | – | 75.99 | 89.52 | – | 61.46 |
| Calcium oxide, | 46.47 | 37.49 | 17.89 | 46.76 | – |
| Magnesium oxide, | 5.05 | – | – | – | – |
| Ferric and aluminic oxides, | 14.35 | – | 14.25 | 5.78 | – |
| Total phosphoric acid, | 19.04 | 21.88 | 21.72 | 27.57 | 15.82 |
| Soluble phosphoric acid, | – | – | – | – | 12.65 |
| Reverted phosphoric acid, | – | 7.55 | – | 4.27 | 2.52 |
| Insoluble phosphoric acid, | – | 14.33 | – | 23.30 | 0.65 |
| Insoluble matter, | 4.39 | 2.45 | 30.50 | 9.04 | 6.26 |

The following fertilizer mixtures have been applied annually to all the plats, with the exception of Plat 3, which received in 1890 ground apatite and in 1891 no phosphate whatever: —

| PLATS. | Annual Supply of Manurial Substances. | Pounds. |
|---|---|---|
| Plat 1 (south, 6,494 square feet), | Ground phosphatic slag, | 127 |
| | Nitrate of soda, | 43 |
| | Potash-magnesia sulphate, | 58 |
| Plat 2 (6,565 square feet), | Ground Mona guano, | 128 |
| | Nitrate of soda, | 43½ |
| | Potash-magnesia sulphate, | 59 |
| Plat 3 (6,636 square feet), | Ground Florida phosphate, | 129 |
| | Nitrate of soda, | 44 |
| | Potash-magnesia sulphate, | 59 |
| Plat 4 (6,707 square feet), | South Carolina phosphate, | 131 |
| | Nitrate of soda, | 44½ |
| | Potash-magnesia sulphate, | 60 |
| Plat 5 (6,778 square feet), | Dissolved bone-black, | 78 |
| | Nitrate of soda, | 45 |
| | Potash-magnesia sulphate, | 61 |

The phosphatic slag, Mona guano, South Carolina phosphate and Florida phosphate were applied at the rate of 850 pounds per acre; dissolved bone-black at the rate of 500 pounds per acre. Nitrate of soda was applied at the rate of 250 pounds per acre and potash-magnesia sulphate at the rate of 390 pounds per acre.

Potatoes were raised upon the plats in 1890; in 1891 winter wheat was employed (for details see ninth annual report); in 1892 serradella was the crop experimented with (see tenth annual report).

*1893.* — The field was ploughed April 29. May 6 the fertilizers were applied broadcast to the various plats, and the land was afterwards thoroughly harrowed and pulverized. May 20 corn, variety "Pride of the North," was planted in hills, eighteen quarts being used. The crop was cultivated three times, and hoed twice during the months of June and July. The corn came in bloom August 1 and was cut September 8. It remained in the field until October 10–13, when the ears of corn were picked. During the entire season Plat 1 appeared to make a larger and more rapid growth than any of the other plats.

*Height of Plants during the Season.*

| PLATS. | July 3. | July 10. | July 17. | July 24. | July 31. | Aug. 7. |
|---|---|---|---|---|---|---|
| Plat 0 (inches), . . | 10 | 12 | 16 | 23 | 25 | 39 |
| Plat 1 (inches), . . | 20 | 32 | 44 | 54 | 73 | 86 |
| Plat 2 (inches), . . | 13 | 20 | 26 | 40 | 63 | 80 |
| Plat 3 (inches), . . | 10 | 14 | 19 | 31 | 46 | 69 |
| Plat 4 (inches), . . | 11 | 15 | 23 | 41 | 57 | 79 |
| Plat 5 (inches), . . | 13 | 17 | 27 | 45 | 55 | 81 |

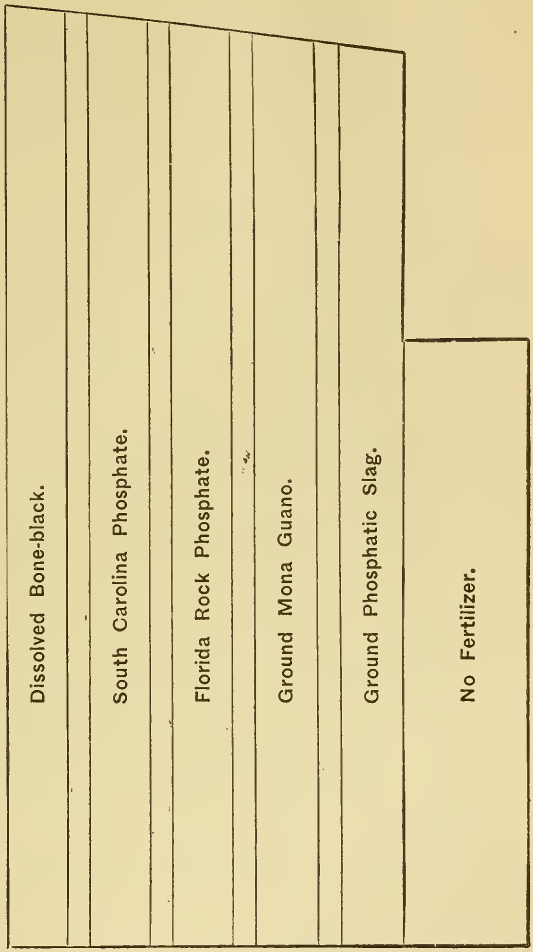
*Yield of Crop.*

| PLATS. | AMOUNT PER PLAT. | | | RATE PER ACRE. | | |
|---|---|---|---|---|---|---|
| | Ears. | Stover. | Total. | Ears. | Stover. | Total. |
| Plat 0, . . . . | – | 650 | 650 | – | 3,660 | 3,660 |
| Plat 1, . . . . | 470¼ | 1,190 | 1,660¼ | 3,195 | 7,985 | 11,180 |
| Plat 2, . . . . | 571 | 810 | 1,381 | 3,791 | 5,378 | 9,169 |
| Plat 3, . . . . | 432 | 915 | 1,347 | 2,834 | 6,002 | 8,836 |
| Plat 4, . . . . | 579½ | 890 | 1,469½ | 3,767 | 5,785 | 9,552 |
| Plat 5, . . . . | 542¼ | 780 | 1,322¼ | 3,486 | 5,015 | 8,501 |

*Relative Ratio of Ears to Stover.*

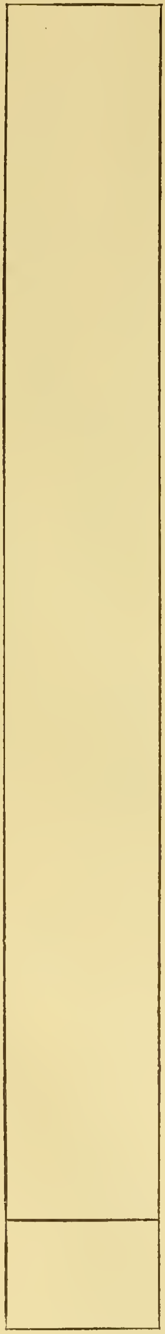
| | |
|---|---|
| Plat 1, . . . . . . . . . . . . | 1 : 2.5 |
| Plat 2, . . . . . . . . . . . . | 1 : 1.4 |
| Plat 3, . . . . . . . . . . . . | 1 : 2.1 |
| Plat 4, . . . . . . . . . . . . | 1 : 1.5 |
| Plat 5, . . . . . . . . . . . . | 1 : 1.4 |

Field "F," 1893.



Scale, 4 rods to 1 inch.

*Corn.*



Field "G," 1893.

Scale, 6 rods to 1 inch.

## 6. Experiments with Corn.

### *Field G.*

This field is 700 feet long and 75 feet wide; area, 52,500 square feet, or 1$\frac{1}{5}$ acres. The land is nearly level and the soil a loam several feet in depth.

May 1 barn-yard manure was applied to the field at the rate of ten tons per acre. A few days later the field was ploughed, harrowed and prepared for planting. The southern end of the field for a distance of fifty feet was planted to artichokes. The remainder of the field was planted to corn, variety "Pride of the North." The corn was planted in hills May 20, sixteen quarts of seed being used. The crop was cultivated June 5 and June 23. August 1 the stalks began to bloom. The crop was cut September 9. Owing to the wet condition of the soil on a portion of the field, the corn on that portion (108 feet of the length of the field) was used for green fodder. The remainder of the crop (.92 acre) stood in the field until October 20, when it was husked.

*Yield of Crop (per Acre).*

| | Pounds. |
|---|---|
| Ears, . . . . . . . | 2,920 |
| Stover, . . . . . . . | 5,917 |
| Total, . . . . . . | 8,837 |

The artichokes were planted May 20 and cultivated throughout the season with the corn. They blossomed late in September. The roots will remain in the ground over winter and are to be dug in the spring.

## 7. FIELD EXPERIMENTS TO COMPARE THE EFFECT OF HOME-MADE MIXED STABLE MANURE, OF UNLEACHED WOOD ASHES AND OF VARIOUS MIXTURES OF COMMERCIAL FERTILIZING MATERIALS ON THE YIELD OF SOME PROMINENT FARM CROPS, WHEN APPLIED AS MANURE UNDER OTHERWISE FAIRLY CORRESPONDING CONDITIONS (1888–94).

### *East Field.*

The land used for these observations covers an area of from seven to eight acres, and is located along the east side of the farm of the station. On its western termination it borders on a meadow in fair condition, and on its eastern side it is separated from a natural thrifty grove by a private road from thirty-five to forty feet wide.

The soil consists of a somewhat sandy loam, with indications of light springs in various parts of the field. The more prominent springs are connected by drain pipes with the main drain of the adjoining meadow since the experiment began.

The entire field slopes gently and quite uniformly from east to west. Corn and grasses represent in the main the crops raised upon the ground in years preceding 1887.

The inferior yield and character of the crops of later years raised upon the land pointed towards an indifferent management, as far as the selection of crops and of manure is concerned. To destroy weeds and other objectionable local growths, it became advisable to introduce a thorough system of drill cultivation.

In the autumn of 1887 the sod which covered the entire area was turned under by ploughing, and subsequently, by a repeated use of a wheel harrow, was thoroughly broken up. One ton of unleached wood ashes (per acre), applied broadcast and slightly ploughed in before the close of the season, served as manure for the coming year (1888).

The succeeding spring, after a thorough mechanical preparation of the soil by ploughing and harrowing, the following crops were planted: potatoes, barley, oats and corn.

They were sown in rows running along the sloping grounds from north to south, to secure favorable conditions for an advantageous and liberal use of a horse cultivator in the interest of clean cultivation.

The crops raised during that season showed a fairly uniform state of productiveness of the entire field here under discussion.

*1889.* — The field experiments with different manures, which are the special subject of this chapter, began during the spring of that year.

The lands previously described are divided by a grass road into two parts, a north and a south field. The former occupies a space of from five to six acres and the latter three to four acres. Each of these fields, running from north to south, was subsequently subdivided into five plats, which were kept separate from each other by a space of land fourteen feet wide, running along the entire length of each plat from east to west. The spaces between adjoining plats were cultivated and planted in connection with the main plats. They received, however, at no time manure of any description during the entire experiment.

The crops selected for the experiment were in all cases planted in the same manner across the five plats set apart for the observation. They occupied in every case, as far as the same crops are concerned, the same area. The mechanical preparation of the soil was alike in case of the same crop; the same statement applies to the special treatment, as cultivating, etc., during the growing season, and to the mode of harvesting.

*The difference in the treatment of the five plats was entirely confined to a different mode of supplying plant food to the crops raised; each plat was treated year after year in the following manner (1889 to 1894):* —

*Fertilizer applied Each Year from 1889 to 1894.*

*Plat I.* — Home-made mixed barn-yard manure, 18,000 pounds (rate of 10 tons per acre).

*Plat II.* — Wood ashes, 1,800 pounds (rate of 1 ton per acre).

*Plat III.* — No fertilizer.

*Plat IV.* — Ground bone, 540 pounds (rate of 600 pounds per acre); muriate of potash, 180 pounds (rate of 200 pounds per acre).

*Plat V.* — Ground bone, 540 pounds (rate of 600 pounds per acre); sulphate of potash and magnesia, 360 pounds (rate of 400 pounds per acre).

*Composition of Fertilizers used.*

| | PER CENT. | | |
|---|---|---|---|
| | Nitrogen. | Phosphoric Acid. | Potassium Oxide. |
| Barn-yard manure, | .568 | .688 | .523 |
| Wood ashes, | – | 1.45 | 7.63 |
| Muriate of potash, | – | – | 46.00 |
| Sulphate of potash and magnesia, | – | – | 24.32 |
| Fine-ground bone, | 4.02 | 22.96 | – |

The basis of the valuation of the essential fertilizing ingredients contained in barn-yard manure is the same as adopted in case of feed stuffs, viz.: —

| | Cents per Pound. |
|---|---|
| Nitrogen, | 17½ |
| Phosphoric acid, | 5 |
| Potassium oxide, | 5½ |

*Market Cost at Amherst of Fertilizers used.*

| | Cost per Plat. | Cost per Acre. |
|---|---|---|
| Plat I., | $29 34 | $32 60 |
| Plat II., | 9 90 | 11 00 |
| Plat IV. | 11 16 | 12 40 |
| Plat V., | 14 83 | 16 48 |

The barn-yard manure was applied broadcast in the fall and ploughed in early in the spring. The wood ashes and commercial fertilizers were applied broadcast and harrowed in before seeding down. The amount of barn-yard manure (plat I.) used is an exceptional one, for the purpose of securing its highest effect. The annual amount of the remaining fertilizers in case of plats II., IV. and V. is within customary farm practice.

| NAME OF CROP RAISED (1889). | Entire Area occupied by the Crop. | Area occupied by the Crop in Each Plat. |
|---|---|---|
| | Acres. | Acres. |
| Barley (in drills two feet apart), | .88 | .158 |
| Barley (broadcast), | .81 | .146 |
| Dent corn, "Pride of the North" (rows three feet three inches apart), | 3.31 | .596 |

*Amount of Seed used per Acre.*

| | Pounds. |
|---|---|
| Barley, in drills, | 57 |
| Barley, broadcast, | 70 |
| Dent corn, "Pride of the North" (rows three feet three inches apart), | 27 |

*Yield of Crops in Each Plat, calculated for One Acre.*

[Pounds.]

| WHOLE CROP. | Plat I. | Plat II. | Plat III. | Plat IV. | Plat V. |
|---|---|---|---|---|---|
| Barley, in drills (matured), | 3,006 | 3,753 | 2,975 | 3,500 | 2,405 |
| Barley, broadcast (matured), | 2,192 | 2,459 | 2,192 | 2,959 | 2,658 |
| Dent corn (kernels glazed), | 18,875 | 19,246 | 15,461 | 20,735 | 19,644 |

Drilled barley when cut contained 44.4 per cent. of solid matter; corn when cut contained 25.4 per cent. of solid matter.

*Conclusion.* — The generally fair state of productiveness of the lands at the beginning of the experiment shows itself in the fact that the unfertilized plat (III.) yields but little less than some of the fertilized plats.

*1890.* — The system of manuring and the general treatment of the soil was the same as in the preceding year.

| Name of Crop raised (1890). | Entire Area occupied by Crop. | Area occupied by Crop in Each Plat. |
|---|---|---|
| | Acres. | Acres. |
| Vetch and oats (broadcast), | .88 | .158 |
| Scotch tares (in drills three feet three inches apart), | .81 | .146 |
| Soja bean (in drills three feet three inches apart), | 2.08 | .374 |

### *Amount of Seed used per Acre.*

Vetch and oats, 80 pounds of oats and 40 pounds of vetch.

| | |
|---|---|
| Scotch tares in drills, | 47 pounds. |
| Soja bean in drills, | 50 pounds. |

### *Yield of Crops in Each Plat, calculated for One Acre.*

[Pounds.]

| Whole Crop. | Plat I. | Plat II. | Plat III. | Plat IV. | Plat V. |
|---|---|---|---|---|---|
| Vetch and oats (green, blooming when cut), | 11,924 | 8,266 | 7,190 | 10,355 | 11,411 |
| Scotch tares (hayed, blooming when cut), | 2,842 | 3,322 | 1,884 | 3,219 | 3,664 |
| Soja bean (green, blooming when cut), | 9,037 | 9,556 | 7,313 | 10,603 | 10,305 |

Vetch and oats when cut contained 20 per cent. dry matter.

Soja bean when cut contained 22 per cent. dry matter.

Scotch tares when cut and dried contained 80 per cent. dry matter.

### *Conclusions.*

1. The effect of the commercial manures applied in case of plats IV. and V. on the yield of crops compares very favorably with that of barn-yard manure (plat I.).

2. Wood ashes have given in our case on the whole quite satisfactory results.

3. The presence in the soil of a liberal amount of organic vegetable matter in all plats, due to the sod turned under (1888–89), has in all probability brought the highest possible manurial effect of wood ashes and commercial fertilizers (plats II., IV., V.).

4. The sulphate of potash-magnesia has given us, in case of leguminous plants, in two out of three cases a better yield of crops than the muriate of potash. The crops are in the majority of cases leguminous plants (clover-like plants).

5. The decline in the yield of the unfertilized as compared with that of the fertilized plats becomes more apparent than in the preceding year.

*1891.* — The system of manuring and the general treatment of the soil corresponded to that in preceding years.

| NAME OF CROP RAISED (1891). | Entire Area occupied by the Crop. | Area occupied by the Crop in Each Plat. |
|---|---|---|
| | Acres. | Acres. |
| Barley (in drills two feet apart), . . . . | 1.68 | .302 |
| Oats (in drills two feet apart), . . . . . | .92 | .165 |
| Oats (broadcast), . . . . . . . . | 1.19 | .214 |

*Amount of Seed used per Acre.*

| | Pounds. |
|---|---|
| Barley, in drills, . . . . . . . . . . | 68 |
| Oats, in drills, . . . . . . . . . . . | 65 |
| Oats, broadcast, . . . . . . . . . . | 78 |

*Yield of Crops in Each Plat, calculated for One Acre.*

[Pounds.]

| | | Plat I | Plat II. | Plat III. | Plat IV. | Plat V. |
|---|---|---|---|---|---|---|
| Barley, in drills, | straw, . . . | 2,000 | 1,952 | 1,526 | 2,179 | 2,219 |
| | grain, . . . | 1,113 | 1,060 | 692 | 1,133 | 1,043 |
| | Total, . . . | 3,113 | 3,012 | 2,218 | 3,312 | 3,262 |
| Oats, in drills, | straw, . . . | 2,263 | 2,558 | 1,636 | 2,878 | 2,448 |
| | grain, . . . | 1,248 | 1,170 | 729 | 1,333 | 1,188 |
| | Total, . . . | 3,511 | 3,728 | 2,365 | 4,211 | 3,636 |
| Oats, broadcast, | straw, . . . | 3,192 | 2,481 | 1,729 | 3,140 | 2,977 |
| | grain, . . . | 897 | 696 | 467 | 1,065 | 991 |
| | Total, . . . | 4,089 | 3,177 | 2,196 | 4,205 | 3,968 |

*Weight of Straw and Grain reduced to a Percentage (1891).*

| | | Plat I. | Plat II. | Plat III. | Plat IV. | Plat V. |
|---|---|---|---|---|---|---|
| | | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. |
| Barley, in drills, | straw, . . . | 64 | 65 | 69 | 66 | 68 |
| | grain, . . . | 36 | 35 | 31 | 34 | 32 |
| Oats, in drills, | straw, . . . | 64 | 69 | 69 | 68 | 67 |
| | grain, . . . | 36 | 31 | 31 | 32 | 33 |
| Oats, broadcast, | straw, . . . | 78 | 78 | 79 | 75 | 75 |
| | grain, . . . | 22 | 22 | 21 | 25 | 25 |

An examination of the above-stated results leads to the following conclusions: —

1. Seeding in drills has in every instance given a larger percentage of grain than seeding broadcast.
2. The yield of the crop on the fertilized plats exceeds as a rule about thirty-three per cent. that of the crop obtained on the unfertilized plat.
3. The results obtained by the aid of commercial manures applied to plats IV. and V. compare very favorably with those obtained with barn-yard manure or wood ashes.
4. Muriate of potash as potash source of plant food in case of grain crops as a rule leads in yield of crops the sulphate of potash-magnesia.

*1892.* — The system of manuring was the same as in preceding years. The general treatment of the soil was alike in all plats.

| NAME OF CROP RAISED (1892). | Entire Area occupied by the Crop. | Area occupied by the Crop in Each Plat. |
|---|---|---|
| | Acres. | Acres. |
| Canada peas and oats (broadcast), . . . | .88 | .158 |
| Soja bean (in drills two and a half feet apart), | .81 | .146 |
| Dent corn, "Pride of the North" (in drills two and a half feet apart, two feet apart in row), . | 3.31 | .596 |

*Amount of Seed used per Acre.*

Canada peas, 2 bushels, and oats, 4 bushels.

| | |
|---|---|
| Soja beans, . . . . | 60 pounds. |
| Dent corn, . . . . | 14 quarts (26 to 28 pounds). |

*Yield of Crop in Each Plat, calculated for One Acre.*

[Pounds.]

| | | Plat I. | Plat II. | Plat III. | Plat IV. | Plat V. |
|---|---|---|---|---|---|---|
| Canada peas and oats (green, in full bloom), . . . . . . | | – | 13,861 | 11,291 | 15,101 | 14,829 |
| Soja bean, . . . . . . . | | * | * | * | * | * |
| Dent corn | Kernels glazing, . . | 25,034 | 20,025 | 13,674 | † | † |
| | Stover, . . . . . | – | – | – | 8,121 | 8,020 |
| | Ears, . . . . . | – | – | – | 1,557 | 1,200 |

* Not weighed, being fed during August and September.

† Cut for silo.

Dent corn when cut for the silo (kernels glazed but soft) contained from 26 to 28 per cent. of dry vegetable matter; peas and oats when cut (in bloom) contained from 15 to 16 per cent. of dry vegetable matter. As the vetch and oats raised upon the same plats in 1890 contained 20 per cent. of dry matter when cut, it will be seen that this crop under fairly corresponding conditions compares well with that of Canada peas and oats, as far as their yield is concerned.

Analyses of: —

1. Vetch and oats (1890).
2. Canada peas and oats (1892).
3. Early-maturing soja bean (when blooming) (1892).

| | PER CENT. | | |
|---|---|---|---|
| | 1. | 2. | 3. |
| Moisture at 100° C., | 76.21 | 86.32 | 72.90 |
| Dry matter, | 23.79 | 13.68 | 27.10 |
| | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | |
| Crude ash, | 7.25 | 6.90 | 11.05 |
| " cellulose, | 31.73 | 26.66 | 24.73 |
| " fat, | 3.37 | 2.29 | 7.22 |
| " protein, | 7.70 | 16.01 | 13.64 |
| Nitrogen-free extract matter, | 49.95 | 48.14 | 43.36 |
| | 100.00 | 100.00 | 100.00 |

*1893.* — The system of manuring the same as in the preceding year; the general preparation of the soil and of the same crops in all plats alike.

| NAME OF CROP RAISED (1893). | Entire Area occupied by the Crop. | Area occupied by Crop in Each Plat. |
|---|---|---|
| | Acres. | Acres. |
| Soja bean (broadcast), | 1.68 | .303 |
| Vetch and oats (broadcast), | 1.38 | .248 |
| Barley (broadcast), | 1.94 | .349 |

*Amount of Seed used per Acre.*

Soja beans (broadcast), 103 pounds.
Vetch, 50 pounds; oats, 4⅔ bushels.
Barley, 2¾ bushels.

*Yield of Crops in Each Plat, calculated per Acre.*

[Pounds.]

| | Plat I. | Plat II. | Plat III. | Plat IV. | Plat V. |
|---|---|---|---|---|---|
| Soja bean (hayed in bloom), . . | 3,564 | 3,498 | 825 | 2,442 | 4,092 |
| Vetch and oats (hayed, cut in full bloom), . . . . . . . | 4,234 | 5,325 | 2,944 | 4,315 | 6,210 |
| Barley, total (dry, matured), . . | 3,837 | 2,579 | 2,178 | 2,894 | 2,149 |

A comparison of the yield of all the fertilized plats with that of the yield of the unfertilized plat shows the following difference in yield per acre, in pounds: —

| | Plat I. | Plat II. | Plat IV. | Plat V. |
|---|---|---|---|---|
| **1889.** | | | | |
| Barley in drills, . . . . . . | 31 | 778 | 525 | —570 |
| Barley broadcast, . . . . . . | * | 267 | 767 | 466 |
| Dent corn (green), . . . . . . | 3,354 | 3,785 | 5,274 | 4,183 |
| **1890.** | | | | |
| Vetch and oats (green), . . . . . | 4,734 | 1,076 | 3,164 | 3,221 |
| Scotch tares (hay), . . . . . . | 958 | 1,438 | 1,338 | 1,780 |
| Soja bean (green), . . . . . . | 1,724 | 2,243 | 3,310 | 2,992 |
| **1891.** | | | | |
| Barley, straw and chaff, . . . . . | 474 | 426 | 653 | 693 |
| Barley, grain, . . . . . . . | 421 | 368 | 441 | 351 |
| Oats in drills, straw and chaff, . . . | 631 | 922 | 1,242 | 812 |
| Oats in drills, grain, . . . . . . | 519 | 441 | 604 | 459 |
| Oats broadcast, straw and chaff, . . | 1,463 | 752 | 1,411 | 1,248 |
| Oats broadcast, grain, . . . . . | 430 | 229 | 598 | 524 |
| **1892.** | | | | |
| Canada peas and oats (green), . . . | – | 2,570 | 3,810 | 3,533 |
| Dent corn (green), . . . . . . | 11,360 | 6,351 | – | – |
| **1893.** | | | | |
| Soja bean (hay), . . . . . . | 2,731 | 2,673 | 1,617 | 3,267 |
| Vetch and oats (hay), . . . . . | 1,290 | 2,379 | 1,371 | 3,266 |
| Barley (matured, whole crop), . . . | 1,659 | 401 | 716 | —29 |

* No difference.

## *Conclusions.*

1. Soja beans should be planted in drills, to keep the weeds down. They grow too slowly to shade the ground sufficiently against objectionable vegetation.

2. Vetch and oats yield larger crops, suitable for green fodder, than soja bean, at an early part of the season. They yield also a larger crop of dry fodder for winter use.

3. Both crops, vetch and oats and soja bean, produce a valuable ensilage. Two weight parts of corn, cut when the kernels are glazing, and one weight part of early-maturing soja bean, have furnished us a valuable ensilage for winter and spring use.

1. Analysis of fodder corn for ensilage.
2. Analysis of corn and soja-bean ensilage.

| | Per Cent. | |
|---|---|---|
| | 1. | 2. |
| Moisture at 100° C., | 68.53 | 77.42 |
| Dry matter, | 31.47 | 22.58 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 5.68 | 9.72 |
| " cellulose, | 22.99 | 25.01 |
| " fat, | 2.81 | 4.29 |
| " protein, | 6.22 | 6.82 |
| Nitrogen-free extract matter, | 62.30 | 54.16 |
| | 100.00 | 100.00 |

## 8. EXPERIMENTS WITH GRASS LAND (MEADOWS).

The meadows under consideration comprise an area of about 9.6 acres. The entire field to 1886 consisted of old, worn-out grass lands, overrun with a worthless growth on its more elevated portion and covered with weeds and sedges in its lower section. The improving of the land by underdraining and ploughing, and subsequently by the use of a system of drill culture, began in some parts (north end) in 1886 and in others (south end) in 1887. For details of this work, see ninth and tenth annual reports (1891–92).

*1893.* — In the spring of this year a change was made in the area and mode of manuring of the grass plats. The area was divided into three plats, Plat 1 (3.97 acres) being the area heretofore covered by plats 1 and 2; Plat 2 (2.59 acres) and Plat 3 (3 acres) correspond to plats 3 and 4 of former years.

The system of manuring adopted was as follows: —

*Plat 1.* — Wood ashes, 1 ton to the acre.
*Plat 2.* — Barn-yard manure, 8 tons to the acre.
*Plat 3.* — Six hundred pounds fine-ground bone and 200 pounds muriate of potash to the acre.

*Yield of Hay (1893).*

| | YIELD PER PLAT. | | | RATE PER ACRE. | | |
|---|---|---|---|---|---|---|
| | Plat 1. | Plat 2. | Plat 3. | Plat 1. | Plat 2. | Plat 3. |
| First cut, | 9.60 | 5.34 | 5.80 | 2.28 | 2.62 | 1.94 |
| Second cut, | 2.99 | 2.22 | 2.67 | .77 | .86 | .64 |
| Total yield, | 12.59 | 7.56 | 8.47 | 3.05 | 3.48 | 2.58 |

*Yield of Hay (1889–93).*

| | Rate per Acre (Tons). | | |
|---|---|---|---|
| | First Cut. | Second Cut. | Total. |
| **1889.** | | | |
| Plat 1, barn-yard manure, 18 tons to acre, | 2.73 | 1.14 | 3.87 |
| Plat 2, barn-yard manure, 8 tons to acre, | 2.38 | 1.21 | 3.59 |
| Plat 3, 600 pounds of steamed bone and 200 pounds muriate of potash, | 2.50 | 1.03 | 3.56 |
| **1890.** | | | |
| Plat 1, barn-yard manure, 14 tons to acre, | 3.80 | 1.00 | 4.80 |
| Plat 2, barn-yard manure, 11 tons to acre, | 3.25 | 1.34 | 4.59 |
| Plat 3, as in 1889, | 3.00 | .73 | 3.73 |
| Plat 4, wood ashes, 1 ton to acre, | 2.23 | .68 | 2.91 |
| **1891.** | | | |
| Plat 1, barn-yard manure, 8 tons to acre, | 3.26 | .72 | 3.98 |
| Plat 2, barn-yard manure, 6 tons to acre, | 2.99 | .72 | 3.71 |
| Plat 3, as in 1890, | 2.32 | .51 | 2.83 |
| Plat 4, as in 1890, | 2.32 | .51 | 2.83 |
| **1892.** | | | |
| Plat 1, as in 1891, | 2.77 | 1.04 | 3.81 |
| Plat 2, as in 1891, | 2.70 | .98 | 3.68 |
| Plat 3, as in 1891, | 2.33 | .64 | 2.97 |
| Plat 4, as in 1891, | 2.18 | 1.02 | 3.20 |
| **1893.** | | | |
| Plats 1 and 2, wood ashes, 1 ton to acre, | 2.28 | .77 | 3.05 |
| Plat 3, barn-yard manure, 8 tons to acre, | 2.62 | .86 | 3.48 |
| Plat 4, 600 pounds ground bone and 200 pounds muriate of potash to acre, | 1.94 | .64 | 2.58 |

## 9. Report on General Farm Work (1893).

The lands assigned for the use of the Massachusetts State Agricultural Experiment Station cover an area of fifty acres. Ten acres are natural woodlands, and forty acres, including the space occupied by the buildings, are used for the raising of farm crops. At present from fifteen to sixteen acres are under cultivation, and from sixteen to seventeen acres are permanent grass lands. As every portion of the land is at present serving for some special experiment, the general management of the farm is to a controlling degree subjected to the requirements of the work called for in connection with the various questions under investigation. The adoption of a thorough mechanical preparation of the soil, supported by a careful, clean cultivation of the crops raised, has brought the lands into a fair condition for field experiments. Each field has had for years its own system of manuring, and becomes thereby from year to year more valuable for experimental purposes. Wherever circumstances have been favorable, forage crops have been chosen, for the purpose of studying the influence of various systems of fertilization and cultivation on their growth and special character. This practice has resulted already in the successful introduction of some valuable forage plants new to our locality, and has also materially assisted us in an economical support of quite extensive experiments in stock feeding. The beneficial effect of many of these crops on the physical and chemical condition of our cultivated lands is everywhere noticed, when compared with their previous general condition.

During the past season several varieties of soja bean, vetch and oats and buckwheat have been raised. The vetch and oats was fed in part green and in part as hay to dairy cows. The soja bean was fed as hay.

Twenty tons of corn have been put into the silos, and the remainder has been fed in part as fodder corn, or has been harvested when matured, and the corn stover obtained will serve for the support of dairy stock in place of hay.

The character and amount of farm and garden crops raised in 1893 may be seen from the following statement: —

| | Tons. |
|---|---|
| Hay (first cut), | $31\frac{1}{3}$ |
| Rowen, | $10\frac{1}{5}$ |
| Potatoes, | $7\frac{1}{2}$ |
| Oats (1,368 pounds grain, 5,032 pounds straw), | $3\frac{1}{5}$ |
| Vetch and oats (hay), | $3\frac{2}{3}$ |
| Vetch and oats (green), | $2\frac{1}{2}$ |
| Fodder corn (green), | $26\frac{1}{2}$ |
| Corn stover, | $5\frac{1}{2}$ |
| Corn (ears), | $2\frac{3}{4}$ |
| Soja bean (hay), | $2\frac{1}{6}$ |
| Barley, | $2\frac{1}{3}$ |
| Rye (226 pounds grain, 1,243 pounds straw), | $\frac{3}{4}$ |
| Buckwheat (green), | $1\frac{1}{4}$ |
| Tomatoes, | $2\frac{1}{4}$ |
| Cabbages, | $1\frac{1}{3}$ |
| Spinach, | $\frac{1}{2}$ |
| Lettuce, | $\frac{1}{6}$ |
| Roots (carrots, 5,540 pounds; beets, 2,194 pounds; turnips, 2,157 pounds), | 5 |
| Miscellaneous, | 3 |
| | $112\frac{9}{10}$ |

## 10. On Special Fertilization with Reference to Some Prominent Industrial Crops, Fruits and Garden Vegetables.

One of the first requirements for a healthful condition and subsequent successful propagation of any plant consists in adopting a well-devised system of fertilization.

A system of manuring may be called well devised or rational when it is based upon the results of a careful examination into the composition of the plant under cultivation, and on a due consideration of its natural qualifications for availing itself of the needed plant food both from the atmosphere and the soil in question. When raised under otherwise corresponding circumstances, plants with a well-developed and extensive root system may prosper where those with a compact one will fail; the same statement applies with equal force to the character of their leaf systems.

To ascertain with certainty the composition of a plant, especially with reference to its soil constituents, requires repeated examinations in different stages of its growth and when raised upon different kinds of soil. The relations of the various mineral constituents of the plant to its successful development must be fairly understood to know what elements of plant food ought to be present in the soil, in an available form, to render success possible.

Most of our farm plants have been carefully investigated, and their requirements regarding kind and amount of the various articles of plant food for their successful production may be considered fairly well understood. This circumstance cannot be claimed with the same certainty regarding the so-called "garden crops" and fruit-producing plants. Our stock of information with regard to these is in an exceptional degree unsatisfactory. The slowness of the exhaustive action of fruit trees on the soil, on account of their extensive root systems, and the beneficial effect of a frequent rotation of crops in case of garden plants, in connection with a customary liberal supply of vegetable refuse material and of home-made manures, have apparently delayed the need of a scientific inquiry into the special wants of the garden and orchard on the part of agricultural chemists. A surplus in the quantity of manurial matter has no doubt quite frequently provided for special wants; and in this view is secured an intelligent explanation of the results. There is no scarcity of valuable testimony to the fact of exceptionally good success in raising fruits and garden crops by the aid of a liberal supply of compound manurial matters, such as barn-yard manure, vegetable compost of various descriptions, wood ashes and others of a similar varying and thus ill-defined composition; yet it is equally well understood that but little satisfactory explanation can be given in many instances regarding the particular relation which exists between the constituents or conditions of such manurial substances applied and the quantity and quality of the crops raised by their aid.

The world-wide reputation of barn-yard manure and wood ashes dates back not merely one or two centuries; their good effects have been known for thousands of years; and we have very good reason to believe that their general reputation rests on their complex character and their beneficial influence over various physical and chemical qualities of the soil. They contain in the majority of cases more or less of all the essential soil constituents which our cultivated farm and garden plants need, and they supply on that account, to some extent at least, not only known but also unknown deficiencies of plant food. They may thus ensure, other circumstances being favorable, for a longer or shorter period of time, reasonable success when applied in suitable quantities.

Experience has shown that refuse manurial matter, like barn-yard manure, is most efficient when used for the reproduction of those crops which contributed materially to its manufacture; a similar view may be maintained with reference to the manurial value of vegetable compost and ashes. The exceptional occurrence of these favorable conditions materially limits, in the light of our present information, their claim of being the best of manures for farm and garden under all circumstances, and needing no further supplementing to meet any special deficiencies of plant food. The whole aspect of the question how to manure efficiently has gradually but decidedly changed within the last fifty years.

We prefer to-day to speak of feeding plants. To secure the best possible results in feeding plants requires information with regard to the three following points: namely, with relation to the physical and chemical character of the soil in question; a knowledge of the special wants of the plant under cultivation, as regards the absolute and relative proportions of the various essential articles of plant food required; and a familiarity with the composition and the general physical properties of the different kinds of manurial matter at our disposal.

A brief statement of the principal results of a systematic, scientific examination into the circumstances which control a healthy and vigorous growth of plants may not be out of place here.

*First.* All our cultivated plants on the farm, in the garden and in the orchard contain the same elementary constituents, yet no two of them in the same absolute amounts and relative proportions. The list comprises carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, potassium, sodium, calcium, magnesium, silicon, chlorine (manganese?).

*Second.* These plant constituents are furnished in part by the surrounding atmosphere, in part by the soil, and some in varying proportions by both.

*Third.* The essential plant constituents are not needed in different plants in the same invariable proportions at the various successive stages of growth, but are wanted at different stages of growth in different absolute amounts and relative proportions. Each kind of plant has its especial wants at different stages of its development. (Grains require much nitrogen in an available form during their later period of growth, when blooming and forming seed, while grape vines need a large amount of potash during the growing and maturing of the fruit, etc )

*Fourth.* The absolute amount of the essential mineral constituents may vary in the same kind of plant when raised on different soils and in different climates without, as a rule, affecting the general character of the plant; yet it appears, however, that not one of the essential elements can to any extent replace another one without affecting more or less seriously the amount and relative proportion of the organic constituents of the plant. It has been noticed that many of our cultivated plants are more or less susceptible of change in that direction, owing to a liberal application of one or the other essential constituent.

*Fifth.* It has also been shown that the particular form of the various articles of plant food, as well as the special associations in which they may be applied, exerts quite frequently a decided influence, not only on the quantity of the crop, but also on its quality.

The observations referred to above (*fourth* and *fifth*) deserve particularly the serious attention of all parties engaged in the raising of industrial crops, as well as garden crops and fruits; in fact, wherever a special quality of the product affects the commercial value of the same. We know that whenever such changes are made they are as apt to be in our favor as against our best interests. The history of the successful production of many of our industrial crops furnishes us with an abundance of illustrations of the existence of such relationships, as in the case of sugar-producing plants, tobacco, etc.

*Sixth.* The natural resources of the soil in available plant food have proved, as a rule, ultimately insufficient for a remunerative management of the farm, the garden and the orchard. Older systems of agriculture have failed on account of a scanty supply of plant food, and many failures in our present system of management will most likely be ascribed at some future day to an indifferent application of the essentials of plant food.

From the foregoing record of well-established conclusions, derived from actual observation in the vegetation house, the field and the garden, we can draw, if we desire, some valuable lessons for our guidance in the practical management of the various branches of agricultural and horticultural industry.

A careful consideration of the points stated cannot fail to impress all interested parties with the fact that to manure our lands efficiently means to-day something more than to incorporate into the soil an exceptionally liberal amount of some incidental refuse matter of ill-defined composition, as barn-yard manure, vegetable compost or wood ashes. Both good economy and the desirability of securing a successful and thus economical production of the various farm and garden crops strongly advise the change from an indifferent system of manuring to a more rational one in every branch of agriculture and horticulture.

The steadily increasing consumption of agricultural chemicals and of commercial manurial compounds, for the purpose of supplementing our home resources of manurial matter, is a gratifying endorsement of the good service which systematic, scientific, experimental investigation into the causes of a successful production of remunerative crops have rendered to practical agriculture and horticulture.

Much has thus far been accomplished, considering the short period of time since our views regarding these points have changed; yet much more work is still necessary to secure a reasonably adequate control of the subject under discussion. To promote these interests it seems to be desirable that agricultural chemists render themselves more familiar with the best current modes of a successful horticultural practice, and that horticulturists make themselves familiar with the more recent results of the scientific investigations made in their interests by giving them a fair and careful trial in the practical pursuit of their business.

Every attempt at a rational and remunerative system of cultivation should begin with an inquiry into the location of the lands and the general condition of soil and climate, to ascertain the special fitness of each for the contemplated industry; and, in case the lands have already been under cultivation for years, their past history with regard to the system of cultivation carried on, as well as the character of the crops raised, ought to be consulted before any particular course of operation is decided upon. Inquiries in these directions cannot fail to give us some valuable insight into the character and extent of existing and available circumstances regarding plant food and the possibilities of success.

A due consideration of the character and amount of the existing available plant food of the soil, and some definite information in regard to the composition of the plant we propose to cultivate, ought to guide us in the selection of the kind and the quantity of the manurial substance. As plants require at different stages of growth different quantities of the essential articles of plant food, it must be the aim to provide a liberal amount of those essential constituents to meet these periodical wants. The well-known fact that liberal manuring pays better than a scanty one finds its explanation in the existence of the above conditions. The heavier the crop the larger should be the return of the constituents carried off from the soil, for that essential article of plant food which is present in the soil in less quantity than the growth of the plant requires controls the final result.

It has been the aim of the writer, since the establishment of the agricultural institutions at Amherst, to furnish object lessons to our farming community in regard to a rational system of fertilization by carrying on a series of field experiments with a variety of farm crops.

The local conditions of the soil with reference to the existing amount of plant food had to be, as far as practicable, determined by actual field trials before the special lines of investigation could be entered upon. Our earlier reports furnish abundant proof of the importance ascribed to a suitable preparation of each experimental plot for the special line of inquiry decided upon.

The natural inherent resources of the soil were usually ascertained by raising for several years in succession, without any manurial addition from outside sources, crops requiring different proportions of the essential articles of plant food, thereby reducing the soil to its normal condition regarding the amount of plant food present, as far as practicable.

Most prominent among the experiments carried on are those with relation to the effect of a liberal supply of the different forms of potash on sugar beets,* sorghum,† grapes,‡ potatoes § and several leguminous and grain crops ; ||

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* See eighth, ninth and eleventh annual reports of the Massachusetts Agricultural College for the years 1871, 1872 and 1874.

† See sixteenth annual report of the Massachusetts Agricultural College for the year 1879.

‡ See thirteenth annual report of the Massachusetts Agricultural College for the year 1876.

§ For details see annual reports of the Board of Control of the Massachusetts State Agricultural Experiment Station for the years 1884-93.

|| For details see annual reports of the Board of Control of the Massachusetts State Agricultural Experiment Station for the years 1884-89.

those with relation to the effect of the different forms of nitrogen (ammonia salts, nitrates and organic nitrogen) on the yield and character of grain crops and leguminous plants;* those to determine the economy of using natural and commercial phosphates in the production of corn and grain crops;† experiments with permanent grass lands (meadows).

Of late our attention has been turned to a special study of the effect of different forms of nitrogen and potassium oxide on the growth of a series of prominent fruit and garden crops, and the results of two years' observations regarding the latter are already reported in detail upon preceding pages (Field C).

To explain the striking differences noticed in the yields of some of those crops, in particular lettuce and tomatoes, when raised with the assistance of either muriate or sulphate of potash, it seemed advisable for confirmation of the results to transfer the investigations to the vegetation house, where, under better-defined circumstances, the special effect of the kind and form of the various articles of plant food supplied could be more clearly demonstrated. A few notes regarding the results thus far obtained are subsequently stated, to invite co-operation on the part of persons interested in the questions involved.

Observations in the plant house with lettuce and spinach, during the winter of 1892–93, were conducted as follows: —

The soil used in the vegetation house was a sandy loam taken a few feet below the surface from a locality which at no time had received an additional supply of manurial matter from an outside source. It was sent through a screen before being used, to remove coarse vegetable matter (roots, etc.) as far as practicable. The beds of the vegetation house were divided into boxes thirty-two inches square and eight inches deep. They were filled with the earth to the depth of six inches, about three hundred pounds being used for the purpose.

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* For details see annual reports of the Board of Control of the Massachusetts State Agricultural Experiment Station for the years 1889–93.

† For details see annual reports of the Board of Control of the Massachusetts State Agricultural Experiment Station for the years 1890–93.

Each box received a fertilizer mixture of its own, nothing but commercial fertilizers and chemicals which had been carefully analyzed being used in their compounding. The amount of potassium oxide, phosphoric acid and nitrogen was the same in each case, the phosphoric acid in all cases being supplied by dissolved bone-black, while the potassium oxide in some cases was in the form of muriate of potash (I., II. and III.), in others of high-grade sulphate (IV., V. and VI.), and in the remainder (VII., VIII. and IX.) by potash-magnesia sulphate. The nitrogen was supplied in the form of sulphate of ammonia (II., IV. and VII), nitrate of soda (I., V. and VIII.) and dried blood (III , VI. and IX). These fertilizer mixtures were thoroughly incorporated with the soil. Each box was planted in part with lettuce and in part with New Zealand spinach. The same lot of seed sufficed for the whole, and the seeding took place on the same day. Throughout the growing period the boxes were treated similarly, as far as temperature and time and amount of watering were concerned.

The relative proportion of fertilizer applied was : of potassium oxide, 3 parts ; of phosphoric acid, 1 part ; and of nitrogen, 1 part. The percentage of the different ingredients added to the soil was as follows : —

| | Per Cent. |
|---|---|
| Potassium oxide, | .00026 |
| Phosphoric acid, | .00009 |
| Nitrogen, | .00009 |

*Fertilizer Mixtures used.*

*Box I.*

90 grams muriate of potash.
100 grams dissolved bone-black.
100 grams nitrate of soda.

*Box II.*

90 grams muriate of potash.
100 grams dissolved bone-black.
100 grams sulphate of ammonia.

*Box III.*

90 grams muriate of potash.
100 grams dissolved bone-black.
140 grams dried blood.

*Box IV.*

90 grams sulphate of potash.
100 grams dissolved bone-black.
75 grams sulphate of ammonia.

*Box V.*

90 grams sulphate of potash.
100 grams dissolved bone-black.
100 grams nitrate of soda.

*Box VI.*

90 grams sulphate of potash.
100 grams dissolved bone-black.
140 grams dried blood.

*Fertilizer Mixtures used* — Concluded.

| *Box VII.* | *Box VIII.* |
|---|---|
| 160 grams potash-magnesia sulphate. | 160 grams potash-magnesia sulphate. |
| 100 grams dissolved bone-black. | 100 grams dissolved bone-black. |
| 75 grams sulphate of ammonia. | 100 grams nitrate of soda. |

*Box IX.*

| | |
|---|---|
| 160 grams | potash-magnesia sulphate. |
| 100 grams | dissolved bone-black. |
| 140 grams | dried blood. |

The lettuce seeded in the boxes containing muriate of potash as the potash source proved a complete failure, as the young plants attained a height of only one and one-half inches, the color of the leaves changed into various shades of red, and growth ceased. In the other boxes the results were less striking, but the most satisfactory growth was obtained in those boxes in which sulphate of potash or sulphate of potash-magnesia furnished the source of potash.

Less marked was the difference in growth of the New Zealand spinach, the plants growing in the boxes containing muriate of potash being less vigorous, yet the difference at the close of the experiment was less marked, except in regard to the time required to reach perfection. The most striking thing noticed with regard to these preliminary experiments was in relation to the apparently injurious effect of muriate of potash on lettuce. This result induced us to repeat the experiment in the vegetation house during the winter of 1893–94, for the exact quantities required to give the most beneficial results can obviously only be ascertained by a series of observations.*

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* The soil in boxes 1, 2 and 3 was analyzed at the close of the observation, with the following result: —

| | No. 1. | No. 2. | No. 3. |
|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. |
| Potassium oxide, | .142 | .136 | .143 |
| Phosphoric acid, | .119 | .137 | .163 |

### *Observations during the Winter of 1893–94.*

The soil turned to account in these experiments was obtained two feet below the surface of an abandoned pasture, which had not received any addition of manurial matter from an outside source for many years.* The soil was screened, thus being freed from coarse material of every description. It consisted of a light loam. Twelve boxes, corresponding in size to those of the previous year (32 by 32 by 8 inches), were employed, each containing about three hundred pounds of the soil, being filled to within one inch of the top. To secure a thorough mixing of the fertilizer and soil, they were worked together with the shovel and the mixture sent twice through the screen. The addition of the fertilizer to the soil was made two weeks in advance of the seeding. A greater variety of fertilizer mixtures was turned to account, including those of the preceding year. The potassium oxide was furnished by muriate of potash (1, 2 and 3), sulphate of potash (4, 5, 6 and 12), carbonate of potash-magnesia (7, 8, 9 and 10) and phosphate of potash (11). The phosphoric acid was supplied by dissolved bone-black (1, 2, 3, 4, 5, 7, 8 and 9), odorless phosphate (6), double superphosphate (10), phosphate of potash (11) and phosphate of ammonia (12). The nitrogen was added in the form of nitrate of soda (1, 4, 7, 10 and 11), sulphate of ammonia (2, 5 and 8), phosphate of ammonia (12) and organic nitrogen (dried blood) (3, 6 and 9). The relative ratio of essential fertilizing constituents applied was four parts potassium oxide, one part phosphoric acid and one part nitrogen. The percentage of the essential elements of plant food applied to the soil was as follows: —

| | Per Cent. |
|---|---|
| Potassium oxide, | .0004 |
| Phosphoric acid, | .0001 |
| Nitrogen, | .0001 |

Following is a statement of the fertilizer mixtures used: —

---

* Analysis of this soil showed: moisture, 14.25 per cent.; potassium oxide, .084 per cent.; and phosphoric acid, .134 per cent.

*Box 1.*

128 grams muriate of potash.
106 grams dissolved bone-black.
106 grams nitrate of soda.

*Box 2.*

128 grams muriate of potash.
106 grams dissolved bone-black.
78 grams sulphate of ammonia.

*Box 3.*

128 grams muriate of potash.
100 grams dissolved bone-black.
155 grams dried blood.

*Box 4.*

128 grams sulphate of potash.
106 grams dissolved bone-black.
106 grams nitrate of soda.

*Box 5.*

128 grams sulphate of potash.
106 grams dissolved bone-black.
78 grams sulphate of ammonia.

*Box 6.*

128 grams sulphate of potash.
90 grams odorless phosphate.
155 grams dried blood.

*Box 7.*

360 grams carbonate of potash-magnesia.
106 grams dissolved bone-black.
106 grams nitrate of soda.

*Box 8.*

360 grams carbonate of potash-magnesia.
106 grams dissolved bone-black.
78 grams sulphate of ammonia.

*Box 9.*

360 grams carbonate of potash-magnesia.
100 grams dissolved bone-black.
155 grams dried blood.

*Box 10.*

136 grams double superphosphate.
360 grams carbonate of potash-magnesia.
106 grams nitrate of soda.

*Box 11.*

200 grams phosphate of potash.
212 grams nitrate of soda.

*Box 12.*

145 grams phosphate of ammonia.
128 grams sulphate of potash.

Analyses of chemicals used in compounding the above mixtures will be found below: —

| | Potassium Oxide. | Phosphoric Acid. | Nitrogen. |
|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. |
| Muriate of potash, | 46.00 | – | – |
| Sulphate of potash, | 50.20 | – | – |
| Potash-magnesia sulphate, | 24.32 | – | – |
| Carbonate of potash-magnesia, | 18.48 | – | – |
| Phosphate of potash, | 32.56 | 35.70 | – |
| Dissolved bone-black, | – | 13.88 | – |
| Odorless phosphate, | – | 18.42 | – |
| Double superphosphate, | – | 47.80 | – |
| Phosphate of ammonia, | – | 43.86 | 10.37 |
| Dried blood, | – | 4.02 | 10.00 |
| Nitrate of soda, | – | – | 14.28 |
| Sulphate of ammonia, | – | – | 19.59 |

A greater variety of garden vegetables was selected for trial. Each box was planted on October 11 with seed of the following: —

Lettuce, variety Hanson.
Spinach, variety New Zealand.
Beets, variety Egyptian.
Tomato, variety Essex Hybrid.

The boxes were treated similarly with regard to temperature and time of watering. To control the experiment, part of the vegetation house was turned to account to raise the same varieties of vegetables in the same soil, properly manured with vegetable compost from a successfully managed hot-bed. On October 17 the lettuce and spinach appeared, and by October 20 the remaining seeds had sprouted. The following notes relating to the different garden vegetables on trial may not be without interest in this connection, although still of a preliminary character: —

*Lettuce.* — The seed germinated well in all cases except with box 12, in which the number was somewhat scanty. During the first two or three weeks of growth the difference in the boxes was not very marked, although on November 20 1, 2 and 3 were noted as being generally of poorer quality than the others, with 4, 5 and 6 next. Nos. 2 and 5 were the poorest in their respective groups, as were the other boxes (8 and 12) in which the nitrogen was furnished by ammonia salts. On December 26 the lettuce was taken from 1, 2, 3, 4, 5 and 6, to make room for other plants; 1, 2 and 3 showed perhaps a less satisfactory growth than the others. January 10 the lettuce was removed from 9 and 10, having made a very satisfactory growth, and on January 10 from 7 and 8, also with a good growth.

*Beets.* — The seed germinated well in all cases, and during the first part of the growing period no very great differences were observed in the general appearance of the various boxes. The following table gives the heights of the plants at different dates: —

### *Height of Beets.*

[Inches.]

| DATE. | BOXES. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. |
| December 5, | 2½ | 2¾ | 4 | 6½ | 3 | 4¾ | 8 | 7½ | 5½ | 8½ | 3½ | 3½ |
| December 19, | 4 | 2¾ | 5 | 8½ | 3 | 6 | 10 | 9 | 7 | 9½ | 8½ | 3½ |

The plants were taken out of boxes 1, 2, 3, 5 and 6 on December 26, having apparently ceased their growth. They remained longer in box 4, which is provided with an arrangement for sub-irrigation, where they made a slightly larger growth. January 31 the plants were removed from boxes 7, 8, 9, 10 and 11, proving to be the best in 7 and 10.

*Spinach.* — This crop grew better in proportion in all the boxes than either of the others. In 1, 2 and 3 it made a fair growth, although not as vigorous as in the remaining boxes; 4, 5 and 6 showed a more vigorous and rapid growth, while 7, 8 and 9 proved to be still more vigorous. Boxes 10 and 11 showed a corresponding relative increase in growth, the plants being removed on January 3, when in bloom.

*Tomatoes.* — The growth of the tomatoes in 1, 2 and 3 was less satisfactory than in most of the others. An opinion regarding the degree of growth under the influence of the different fertilizers may be noticed from the following table, expressing the height of the plants at different periods of the observation: —

### *Height of Tomato Plants.*

[Inches.]

| DATE. | BOXES. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. |
| December 5, | 5½ | 2¾ | 3 | 8 | 5 | 5 | 6½ | 8½ | 8 | 13½ | 9 | 8½ |
| December 19, | 9½ | 6½ | 7 | 18 | 10 | 11½ | 11 | 14 | 14 | 24 | 21 | 21 |
| January 9, | 26 | 10 | 25 | 36 | 22 | 22 | 28 | 31 | 32 | 45 | 44 | 43 |

The plants came in bloom as follows: in box 10, on December 18; in box 11, on December 20; in box 12, on December 23; in boxes 4, 5, 6, 7, 8 and 9 on January 1; and in boxes 1 and 3 on January 3. The plants in box 2 came in bloom February 15.

Fruit was formed first on the plants in box 10, noticed on January 17. It first appeared in box 12 on January 18; in boxes 4 and 9 on January 21; in box 3 on January 24; in box 1 on January 27; in box 8 on February 5; and in box 7 on February 28.

Fruit ripened in box 10 on February 20; in boxes 3, 4 and 12 on February 28; in box 9 on March 1; and in box 8 on March 7.

The plants grown in the soil manured with vegetable compost, as a sort of control experiment, made a very vigorous and healthy growth, but blossomed late and had formed no fruit up to March 8, although retaining their promising appearance.

Besides the above, the investigations during the close of the present winter season have been extended to the following garden vegetables, namely: peas, beans, onions, cauliflower, radish and turnip.

### *Some General Considerations for Garden Farmers.*

1. Garden crops have usually a short period of growth, and for this reason need a soil rich in available plant food of various kinds, to meet periodical wants.

2. An excessive accumulation of half-decayed vegetable matter, as stable manure and compost prepared from the healthy refuse material of the garden, should be guarded against, in order to prevent, as far as practicable, the development of objectionable parasitic growths. Both sources of manurial matter are very valuable in their way, if used in limited quantities and properly supplemented by chemical manures and commercial fertilizers, to meet the special wants of the crops under cultivation.

3. A liberal use of commercial fertilizers and chemical manures for the production of garden vegetables and fruits deserves commendation, for they enable us to meet more directly the special wants of any soil for the production of crops raised in succession during the same season on the same lands. An excessive accumulation of soluble salines has, however, to be avoided, for some garden vegetables, as lettuce, etc., are very sensitive to their influence (see our observation).

4. It is advisable wherever practicable to change the position of different garden crops from season to season, to regulate the accumulation of the various essential constitu-

ents of plant food by raising vegetables consuming them in different proportions.

5. Wherever the quality of a crop controls its economical and commercial value, it seems advisable that care should be taken to secure the exclusion of an accumulation of soluble saline substances not called for by the crop. This circumstance deserves particular attention in cultivation under glass, where the body of soil is limited, and the removal of such substances by percolation to the lower layers offers but little chance of relief. In our experiment above described this view of the question of supplying plant food in the greenhouse has guided us in selecting a series of concentrated chemical manures, which for the above reason are now recommended for patronage.

6. There are, for obvious reasons, no unfailing receipts for a general fertilizer mixture best adapted to all kinds of soil for the production of field and garden crops, yet there are certain relative proportions of the essential articles of plant food which seem to recommend themselves for the raising of vegetables for the market. A mixture containing the proportion of twenty-four per cent. potassium oxide, twelve per cent. phosphoric acid and twelve per cent. nitrogen deserves a careful trial. In some cases it has been found advisable to add nitrogen at different times in small quantities in the form of nitrate of soda. This should be added at different stages of growth, and has been found desirable in the case of cabbages, turnips, cucumbers, onions, lettuce, asparagus, strawberries, grapes, fruit trees, etc. Peas, beans and all leguminous crops need no such addition, for after reaching a certain size they are qualified, by bacterial action upon their roots, to benefit by the elementary nitrogen of the atmosphere in sufficient amounts to secure success.

7. A regular periodical addition of a moderate amount of organic animal and vegetable refuse matter, as barn-yard manure and vegetable compost, may form an efficient part of the system of manuring adopted.

8. It has been found advantageous, in starting the cultivation of garden vegetables and orchards upon new lands, to enrich the lower layers of the soil by deep ploughing, together with the addition of a liberal supply of natural and commercial phosphates (South Carolina, Florida or odorless

phosphates, etc.), a treatment which may be repeated from time to time whenever practicable.

9. A periodical application of burnt lime or carbonate of lime has been found as a rule advantageous to lands used for the cultivation of garden vegetables wherever an excessive accumulation of organic vegetable matter is apt to occur (from one thousand to fifteen hundred pounds per acre may be used). The presence of a liberal amount of calcium carbonate in our cultivated lands is known to assist in many instances in the liberation of plant food from the soil and refuse vegetable material, and also to favor a beneficial bacterial life in the soil under cultivation.

The subsequent tabular statement of the composition of various garden crops, taken from the tables of E. Wolff and from observations made at Amherst, may not be without interest in this connection: —

*Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Fruits and Garden Crops.*

| | Phosphoric Acid. | Potassium Oxide. | Nitrogen. |
|---|---|---|---|
| *Chenopodiaceæ:* — | | | |
| Mangolds, | 1 | 6 | 2.3 |
| *Mangolds, | 1 | 4.2 | 2.1 |
| Mangold leaves, | 1 | 4.5 | 3 |
| Sugar beets, | 1 | 4.2 | 1.8 |
| *Sugar beets, | 1 | 4.8 | 2.2 |
| Sugar beet tops, | 1 | 2.3 | 1.7 |
| Sugar beet leaves, | 1 | 5.7 | 4.3 |
| Sugar beet seed, | 1 | 1.5 | - |
| *Red beets, | 1 | 4.1 | 3.3 |
| Spinach, | 1 | 1.7 | 3.1 |
| *Spinach, | 1 | 19.2 | 6.8 |
| *Compositæ:* — | | | |
| Lettuce, | 1 | 5.3 | - |
| *Lettuce, | 1 | 7.6 | 4 |
| Head lettuce, | 1 | 3.9 | 2.2 |
| Roman lettuce, | 1 | 2.3 | 1.8 |
| *Jerusalem artichoke, | 1 | 2.8 | 2.7 |
| *Convolvulaceæ:* — | | | |
| Sweet potato, | 1 | 4.6 | 3 |

*Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Fruits and Garden Crops* — Continued.

| | Phosphoric Acid. | Potassium Oxide. | Nitrogen. |
|---|---|---|---|
| *Cruciferæ:* — | | | |
| White turnips, . . . . . | 1 | 3.6 | 2.3 |
| *White turnips, . . . . . | 1 | 3.9 | 1.8 |
| White turnip leaves, . . | 1 | 3.1 | 3.3 |
| *Ruta-bagas, . . . . . | 1 | 4.1 | 1.6 |
| Savoy cabbage, . . . . . | 1 | 1.9 | 2.5 |
| White cabbage, . . . . . | 1 | 4.1 | 1.7 |
| *White cabbage, . . . . . | 1 | 11.0 | 7.6 |
| Cauliflower, . . . . . | 1 | 2.3 | 2.5 |
| Horse-radish, . . . . . | 1 | 3.9 | 2.2 |
| Radishes, . . . . . . | 1 | 3.2 | 3.8 |
| Kohlrabi, . . . . . . | 1 | 1.6 | 1.8 |
| *Cucurbitaceæ:* — | | | |
| Cucumbers, . . . . . | 1 | 2 | 1.3 |
| Pumpkins, . . . . . . | 1 | .6 | .7 |
| *Ericaceæ:* — | | | |
| *Cranberries, . . . . . | 1 | 3 | – |
| *Cranberries, . . . . . | 1 | 3.4 | 2.6 |
| *Gramineæ:* — | | | |
| Corn, whole plant, green, . | 1 | 3.7 | 1.9 |
| *Corn, whole plant, green, . | 1 | 2.2 | 2.8 |
| Corn kernels, . . . . . | 1 | .6 | 2.8 |
| *Corn kernels, . . . . . | 1 | .6 | 2.6 |
| *Corn, whole ears, . . . . | 1 | .8 | 2.5 |
| *Corn stover, . . . . . | 1 | 4.4 | 3.7 |
| *Leguminosæ:* — | | | |
| Hay of peas, cut green, . . | 1 | 3.4 | 3.4 |
| *Cow-pea (Dolichos), . . . | 1 | 3.1 | 2.9 |
| *Small pea (Lathyrus), . . | 1 | 3.4 | 4.2 |
| Peas (seed), . . . . . | 1 | 1.2 | 4.3 |
| Pea straw, . . . . . . | 1 | 2.8 | 4 |
| Garden beans (seed), . . | 1 | 1.2 | 4 |
| Bean straw, . . . . . | 1 | 3.3 | – |
| *Liliaceæ:* — | | | |
| Asparagus, . . . . . | 1 | 1.3 | 3.6 |
| Onions, . . . . . . | 1 | 1.9 | 2.1 |
| *Onions, . . . . . . | 1 | 2.6 | – |

*Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Fruits and Garden Crops* — Concluded.

| | Phosphoric Acid. | Potassium Oxide. | Nitrogen. |
|---|---|---|---|
| *Rosaceæ:* — | | | |
| Apples, . . . . . . | 1 | 2.7 | 2 |
| *Apples, . . . . . . | 1 | 1.9 | 1.3 |
| *Peaches, . . . . . . | 1 | 1.3 | – |
| Pears, . . . . . . | 1 | 3.6 | 1.2 |
| Strawberries, . . . . | 1 | 1.4 | – |
| *Strawberries, . . . . | 1 | 2.6 | – |
| *Strawberry vines, . . . | 1 | .7 | – |
| Cherries, . . . . . . | 1 | 3.3 | – |
| Plums, . . . . . . | 1 | 4.3 | – |
| *Saxifragaceæ:* — | | | |
| *Currants, white, . . . | 1 | 2.8 | – |
| *Currants, red, . . . . | 1 | 2.1 | – |
| Gooseberries, . . . . | 1 | 1.9 | – |
| *Solanaceæ:* — | | | |
| Potatoes, . . . . . . | 1 | 3.6 | 2.1 |
| *Potatoes, . . . . . . | 1 | 4.1 | 3 |
| Potato tops, nearly ripe, . . | 1 | 2.7 | 3.1 |
| Potato tops, unripe, . . . | 1 | 3.7 | 5.3 |
| *Tomatoes, . . . . . . | 1 | 8.7 | 4.5 |
| Tobacco leaves, . . . . | 1 | 6.2 | 5.3 |
| Tobacco stalks, . . . . | 1 | 3.1 | 2.7 |
| Tobacco stems, . . . . | 1 | 10.7 | 3.8 |
| *Umbelliferæ:* — | | | |
| Carrots, . . . . . . | 1 | 2.7 | 2 |
| *Carrots, . . . . . . | 1 | 5.7 | 1.7 |
| Carrot tops, . . . . . | 1 | 2.9 | 5.1 |
| *Carrot tops, dry, . . . | 1 | 8 | 5.1 |
| Parsnips, . . . . . . | 1 | 3.8 | 2.8 |
| *Parsnips, . . . . . . | 1 | 3.3 | 1.2 |
| Celery, . . . . . . | 1 | 3.5 | 1.1 |
| *Vitaceæ:* — | | | |
| Grapes, . . . . . . | 1 | 3.6 | 1.2 |
| Grape seed, . . . . . | 1 | 1 | 2.7 |

## *Fertilizing Constituents of Fruits and Garden Crops.*

[Average amounts in 1,000 parts of fresh or air-dry substance.]

| | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|---|---|---|---|---|---|---|---|---|---|---|
| *Chenopodiaceæ:* — | | | | | | | | | | |
| Mangolds, | 880 | 1.8 | 9.1 | 4.8 | 1.5 | .3 | .4 | .8 | .3 | .9 |
| *Mangolds, | 873 | 1.9 | 12.2 | 3.8 | 1.3 | .6 | .4 | .9 | – | – |
| Mangold leaves, | 905 | 3.0 | 14.6 | 4.5 | 2.8 | 1.6 | 1.4 | 1.0 | .8 | 2.3 |
| Sugar beets, | 805 | 1.6 | 7.1 | 3.8 | .6 | .4 | .6 | .9 | .3 | .3 |
| *Sugar beets, | 869 | 2.2 | 10.4 | 4.8 | .8 | .6 | .4 | 1.0 | .1 | – |
| Sugar beet tops, | 840 | 2.0 | 9.6 | 2.8 | 2.3 | .9 | 1.1 | 1.2 | .2 | .3 |
| Sugar beet leaves, | 897 | 3.0 | 15.3 | 4.0 | 2.0 | 3.1 | 1.7 | .7 | .8 | 1.3 |
| Sugar beet seed, | 146 | – | 45.3 | 11.1 | 4.2 | 10.2 | 7.3 | 7.5 | 2.0 | 1.9 |
| *Red beets, | 877 | 2.4 | 11.3 | 4.4 | .9 | .5 | .3 | .9 | – | – |
| Spinach, | 903 | 2.4 | 16.0 | 2.7 | 5.7 | 1.9 | 1.0 | 1.6 | 1.1 | 1.0 |
| *Spinach, | 922 | 3.4 | 9.6 | 9.6 | 2.1 | .6 | .5 | .5 | – | – |
| *Compositeæ:* — | | | | | | | | | | |
| Lettuce, common, | 940 | – | 8.1 | 3.7 | .8 | .5 | .2 | .7 | .3 | .4 |
| Head lettuce, | 943 | 2.2 | 10.3 | 3.9 | .8 | 1.5 | .6 | 1.0 | .4 | .8 |
| *Head lettuce, | 970 | 1.2 | – | 2.3 | .2 | .3 | .1 | .3 | – | – |
| Roman lettuce, | 925 | 2.0 | 9.8 | 2.5 | 3.5 | 1.2 | .4 | 1.1 | .4 | .4 |
| Artichoke, | 811 | – | 10.1 | 2.4 | .7 | 1.0 | .4 | 3.9 | .5 | .2 |
| *Artichoke, Jerusalem, | 775 | 4.6 | – | 4.8 | – | – | – | 1.7 | – | – |
| *Convolvulaceæ:* — | | | | | | | | | | |
| Sweet potato, | 758 | 2.4 | 7.4 | 3.7 | .5 | .7 | .3 | .8 | .4 | .9 |
| *Cruciferæ:* — | | | | | | | | | | |
| White turnips, | 920 | 1.8 | 6.4 | 2.9 | .6 | .7 | .2 | .8 | .7 | .3 |
| *White turnips, | 895 | 1.8 | 10.1 | 3.9 | .8 | .9 | .3 | 1.0 | 1.0 | – |
| White turnip leaves, | 898 | 3.0 | 11.9 | 2.8 | 1.1 | 3.9 | .5 | .9 | 1.1 | 1.2 |
| *Ruta-bagas, | 891 | 1.9 | 10.6 | 4.9 | .7 | .9 | .3 | 1.2 | – | – |
| Savoy cabbage, | 871 | 5.3 | 14.0 | 3.9 | 1.4 | 3.0 | .5 | 2.1 | 1.2 | 1.1 |
| White cabbage, | 900 | 3.0 | 9.6 | 4.3 | .8 | 1.2 | .4 | 1.1 | 1.3 | .5 |
| *White cabbage, | 984 | 2.3 | – | 3.4 | .3 | .2 | .1 | .2 | – | – |
| Cabbage leaves, | 890 | 2.4 | 15.6 | 5.8 | 1.5 | 2.8 | .6 | 1.4 | 2.4 | 1.3 |
| Cauliflower, | 904 | 4.0 | 8.0 | 3.6 | .5 | .5 | .3 | 1.6 | 1.0 | .3 |
| Horse-radish, | 767 | 4.3 | 19.7 | 7.7 | .4 | 2.0 | .4 | 2.0 | 4.9 | .3 |
| Radishes, | 933 | 1.9 | 4.9 | 1.6 | 1.0 | .7 | .2 | 4.5 | .3 | .5 |
| Kohlrabi, | 850 | 4.8 | 12.3 | 4.3 | .8 | .4 | .8 | 2.7 | 1.1 | .6 |

*Fertilizing Constituents of Fruits and Garden Crops* — Continued.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

| | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|---|---|---|---|---|---|---|---|---|---|---|
| *Cucurbitaceæ:* — | | | | | | | | | | |
| Cucumbers, . . . . . | 956 | 1.6 | 5.8 | 2.4 | .6 | .4 | .2 | 1.2 | .4 | .4 |
| Pumpkins, . . . . . | 900 | 1.1 | 4.4 | .9 | .9 | .3 | .2 | .7 | .3 | .4 |
| *Ericaceæ:* — | | | | | | | | | | |
| *Cranberries, . . . . . | 996 | - | 1.8 | .9 | .1 | .3 | .1 | .3 | - | - |
| *Cranberries, . . . . . | 894 | .8 | - | 1.0 | - | .2 | .1 | .3 | - | - |
| *Gramineæ:* — | | | | | | | | | | |
| Corn, whole plant, green, . | 829 | 1.9 | 10.4 | 3.7 | .5 | 1.4 | 1.1 | 1.0 | .3 | .5 |
| *Corn, whole plant, green, . | 786 | 4.1 | - | 3.8 | .5 | 1.5 | .9 | 1.5 | - | - |
| Corn kernels, . . . . . | 144 | 16.0 | 12.4 | 3.7 | .1 | .3 | 1.9 | 5.7 | .1 | .2 |
| *Corn kernels, . . . . . | 100 | 18.2 | - | 4.0 | .3 | .3 | 2.1 | 7.0 | - | - |
| *Corn, whole ears, . . . | 90 | 14.1 | - | 4.7 | .6 | .2 | 1.8 | 5.7 | - | - |
| *Corn stover, . . . . . | 282 | 11.2 | 37.4 | 13.2 | 7.9 | 5.2 | 2.6 | 3.0 | - | - |
| *Leguminosæ:* — | | | | | | | | | | |
| Hay of peas, cut green, . | 167 | 22.9 | 62.4 | 23.2 | 2.3 | 15.6 | 6.3 | 6.8 | 5.1 | 2.0 |
| *Cow-pea (Dolichos), green, . | 788 | 2.9 | - | 3.1 | .6 | 3.0 | 1.0 | 1.0 | - | - |
| *Small pea (Lathyrus), dry, . | 90 | 38.5 | - | 25.7 | 4.7 | 17.9 | 5.0 | 9.0 | - | - |
| Peas (seed), . . . . . | 143 | 35.8 | 23.4 | 10.1 | .2 | 1.1 | 1.9 | 8.4 | .8 | .4 |
| Pea straw, . . . . . | 160 | 10.4 | 43.1 | 9.9 | 1.8 | 15.9 | 3.5 | 3.5 | 2.7 | 2.3 |
| Garden beans (seed), . . | 150 | 39.0 | 27.4 | 12.1 | .4 | 1.5 | 2.1 | 9.7 | 1.1 | .3 |
| Bean straw, . . . . . | 166 | - | 40.2 | 12.8 | 3.2 | 11.1 | 2.5 | 3.9 | 1.7 | 3.1 |
| *Liliaceæ:* — | | | | | | | | | | |
| Asparagus, . . . . . | 933 | 3.2 | 5.0 | 1.2 | .9 | .6 | .2 | .9 | .3 | .3 |
| Onions, . . . . . . | 860 | 2.7 | 7.4 | 2.5 | .2 | 1.6 | .3 | 1.3 | .4 | .2 |
| *Onions, . . . . . . | 892 | - | 4.9 | 1.8 | .1 | .4 | .2 | .7 | - | - |
| *Rosaceæ:* — | | | | | | | | | | |
| Apples, . . . . . . | 831 | .6 | 2.2 | .8 | .6 | .1 | .2 | .3 | .1 | - |
| *Apples, . . . . . . | 799 | 1.3 | 4.1 | 1.9 | .3 | .3 | .3 | .1 | - | - |
| *Peaches, . . . . . . | 884 | - | 3.4 | 2.5 | - | .1 | .2 | .5 | - | - |
| Pears, . . . . . . | 831 | .6 | 3.3 | 1.8 | .3 | .3 | .2 | .5 | .2 | - |
| Strawberries, . . . . . | 902 | - | 3.3 | .7 | .9 | .5 | - | .5 | .1 | .1 |
| *Strawberries, . . . . . | - | - | 5.2 | 2.6 | .2 | .7 | .4 | 1.0 | - | - |
| *Strawberry vines, . . . . | - | - | 33.4 | 3.5 | 4.5 | 12.2 | 1.3 | 4.8 | - | - |
| Cherries, . . . . . . | 825 | - | 3.9 | 2.0 | .1 | .3 | .2 | .6 | .2 | .1 |
| Plums, . . . . . . | 838 | - | 2.9 | 1.7 | - | .3 | .2 | .4 | .1 | - |

*Fertilizing Constituents of Fruits and Garden Crops* — Concluded.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

| | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|---|---|---|---|---|---|---|---|---|---|---|
| *Saxifragaceæ:* — | | | | | | | | | | |
| *Currants, white, . . . . | – | – | 5.9 | 3.1 | .2 | 1. | .3 | 1.1 | – | – |
| *Currants, red, . . . . | 871 | – | 4.1 | 1.9 | .2 | .8 | .3 | .9 | – | – |
| Gooseberries, . . . . | 903 | – | 3.3 | 1.3 | .3 | .4 | .2 | .7 | – | – |
| *Solanaceæ:* — | | | | | | | | | | |
| Potatoes, . . . . . . | 750 | 3.4 | 9.5 | 5.8 | .3 | .3 | .5 | 1.6 | .6 | .3 |
| *Potatoes, . . . . . . | 798 | 2.1 | 9.9 | 2.9 | .1 | .1 | .2 | .7 | – | – |
| Potato tops, nearly ripe, . | 770 | 4.9 | 19.7 | 4.3 | .4 | 6.4 | 3.3 | 1.6 | 1.3 | 1.1 |
| Potato tops, unripe, . . | 825 | 6.3 | 16.5 | 4.4 | .3 | 5.1 | 2.4 | 1.2 | .8 | .9 |
| *Tomatoes, . . . . . | 940 | 1.7 | – | 3.6 | – | .3 | .2 | .4 | – | – |
| Tobacco leaves, . . . | 180 | 34.8 | 140.7 | 40.7 | 4.5 | 50.7 | 10.4 | 6.6 | 8.5 | 9.4 |
| Tobacco stalks, . . . | 180 | 24.6 | 64.7 | 28.2 | 6.6 | 12.4 | .5 | 9.2 | 2.2 | 2.4 |
| *Tobacco stems, . . . | 106 | 22.9 | 140.7 | 64.6 | 3.4 | 38.9 | 12.3 | 6.0 | – | – |
| *Umbelliferæ:* — | | | | | | | | | | |
| Carrots, . . . . . . | 850 | 2.2 | 8.2 | 3.0 | 1.7 | .9 | .4 | 1.1 | .5 | .4 |
| *Carrots, . . . . . . | 898 | 1.5 | 9.2 | 5.1 | .6 | .7 | .2 | .9 | – | – |
| Carrot tops, . . . . . | 822 | 5.1 | 23.9 | 2.9 | 4.7 | 7.9 | .8 | 1.0 | 1.8 | 2.4 |
| Carrot tops, dry, . . . | 98 | 31.3 | 125.2 | 48.8 | 40.3 | 20.9 | 6.7 | 6.1 | – | – |
| Parsnips, . . . . . . | 793 | 5.4 | 10.0 | 5.4 | .2 | 1.1 | .6 | 1.9 | .5 | .4 |
| *Parsnips, . . . . . . | 803 | 2.2 | – | 6.2 | .1 | .9 | .5 | 1.9 | – | – |
| Celery, . . . . . . | 841 | 2.4 | 17.6 | 7.6 | – | 2.3 | 1.0 | 2.2 | 1.0 | 2.8 |
| *Vitaceæ:* — | | | | | | | | | | |
| Grapes, . . . . . . | 830 | 1.7 | 8.8 | 5.0 | .1 | 1.0 | .4 | 1.4 | .5 | .1 |
| Grape seed, . . . . . | 110 | 19.0 | 22.7 | 6.9 | .5 | 5.6 | 1.4 | 7.0 | .8 | .1 |

Most of the foregoing analyses were compiled from the tables of E. Wolff. Those marked * are from analyses made at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

# PART III.

## SPECIAL WORK IN THE CHEMICAL LABORATORY.

C. A. Goessmann.

- I. Communication on Commercial Fertilizers: —
    - 1. General Introduction.
    - 2. State Laws for the Regulation of Trade in Commercial Fertilizers.
    - 3. List of Licensed Manufacturers and Dealers from May 1, 1893, to May 1, 1894 (52).
    - 4. Analyses of Licensed Fertilizers (214).
    - 5. Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination (169).
    - 6. Miscellaneous Analyses (7).
    - 7. Miscellaneous Fodder Analyses (45).
- II. Analyses of Milk sent on for Examination (26).
- III. Analyses of Water sent on for Examination (93).
- IV. Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.
- V. Compilation of Analyses made at Amherst, Mass., of Fodder Articles, Fruits, Sugar-producing Plants, Dairy Products, etc.
- VI. Table of the Digestibility of American Feeding Stuffs (compiled by J. B. Lindsey): —
    - A. Experiments with Ruminants.
    - B. Experiments with Swine.

# I.

# COMMUNICATION ON COMMERCIAL FERTILIZERS.

1. General introduction.
2. State laws for the regulation of trade in commercial fertilizers.
3. List of licensed manufacturers and dealers from May 1, 1893, to May 1, 1894.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.
7. Miscellaneous fodder analyses.

## 1. General Introduction.

Fifty-two manufacturers and dealers have applied for and received licenses for the sale of their various brands in our State. Twenty-four of them are residents of other States.

Two hundred and thirty-five samples of licensed articles have been collected in all parts of the State by authorized agents of the station. Two hundred and fourteen of them have been carefully analyzed at the chemical laboratory of the station, with the following results: one sample contained all three essential constituents above the highest guarantee; seventeen samples contained two of the essential elements above the highest guarantee; forty-five contained one essential element above the highest guarantee; sixty-eight contained three essential elements at the lowest guarantee; fifty-seven contained two essential elements at the lowest guarantee; thirty-one contained one element at lowest guarantee; one sample contained three essential elements below the lowest stated guarantee; fourteen samples contained two essential elements below the lowest stated guarantee; fifty-one contained one element below the lowest stated guarantee.

The deficiency in one or two essential constituents was in the majority of instances compensated for by an excess in the others.

The variations in the market price of prominent fertilizer constituents have been, on the whole, during the past year within the usual limits. Phosphoric acid in all forms has been offered at a somewhat lower figure than last year, while nitrogen in its leading forms has been somewhat higher.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary to *discriminate*, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, *between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties.* In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition and to such additional information as relates to the latter.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a *consideration of the particular composition of the different brands of fertilizers offered for their patronage, a circumstance not infrequently overlooked.*

The *approximate market value* of the different brands of fertilizers obtained by the current mode of valuation does not express *their respective agricultural value*, *i. e.*, their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated and the special wants of the crops to be raised by their assistance.

To select judiciously from among the various brands of fertilizers offered for patronage requires, in the main, two kinds of information, namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals and of the higher-priced compound fertilizers depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food, *i. e.*, phosphoric acid, nitrogen and potash, which they contain. To ascertain by this mode of valuation the approximate market value of a fertilizer (*i. e.*, the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

*Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1893.*

| | Cents per Pound. |
|---|---|
| Nitrogen in ammonia salts, | 17 |
| Nitrogen in nitrates, | 15½ |
| Organic nitrogen in dry and fine-ground fish, meat, blood, and in high-grade mixed fertilizers, | 17½ |
| Organic nitrogen in cotton-seed meal, linseed meal and castor pomace, | 16½ |
| Organic nitrogen in fine-ground bone and tankage, | 15 |
| Organic nitrogen in fine-ground medium bone and tankage, | 12 |

*Trade Values of Fertilizing Ingredients, etc.* — Concluded.

| | Cents per Pound. |
|---|---|
| Organic nitrogen in medium bone and tankage, | 9 |
| Organic nitrogen in coarse bone and tankage, | 7 |
| Organic nitrogen in hair, horn shavings and coarse fish scraps, | 7 |
| Phosphoric acid soluble in water, | 6½ |
| Phosphoric acid soluble in ammonium citrate, | 6 |
| Phosphoric acid in fine bone and tankage, | 6 |
| Phosphoric acid in fine medium bone and tankage, | 5 |
| Phosphoric acid in medium bone and tankage, | 4 |
| Phosphoric acid in coarse bone and tankage, | 3 |
| Phosphoric acid in fine-ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes, | 5 |
| Phosphoric acid insoluble (in ammonium citrate) in mixed fertilizers, | 2 |
| Potash as high-grade sulphate, and in mixtures free from muriate, | 5½ |
| Potash as muriate, | 4½ |

The manurial constituents contained in feed stuffs are valued as follows: —

| | Cents per Pound. |
|---|---|
| Organic nitrogen, | 17½ |
| Phosphoric acid, | 5 |
| Potash, | 5½ |

The organic nitrogen in *superphosphates, special manures and mixed fertilizers of a high grade* is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, fifteen and a half cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones or other equally good forms, and not from leather, shoddy, hair or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. The insoluble phosphoric acid is valued in this connection at two cents.

The above trade values are the figures at which, in the six months preceding March, 1893, the respective ingredients could be bought at *retail for cash in our large markets, in the raw materials*, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent.

in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as: —

Sulphate of ammonia,
Nitrate of soda,
Muriate of potash,
Sulphate of potash,
Dried blood,
Dried ground meat,
Dry ground fish,
Azotin,
Ammonite,
Castor pomace,
Bone and tankage,
Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guarantee of composition with reference to their essential constituents, and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Our present laws for the regulation of the trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes when offered for sale in our market at ten dollars or more per ton. Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

## 2. THE PROVISIONS OF THE ACT ARE AS FOLLOWS:

[CHAPTER 296.]

### AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

*Be it enacted, etc., as follows:*

SECTION 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

SECT. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SECT. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

Sect. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

Sect. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

Sect. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

Sect. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*]

### *Instructions to Manufacturers, Importers, Agents and Sellers of Commercial Fertilizers or Materials used for Manurial Purposes in Massachusetts.*

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

*First*, with a distinct statement of the name of each brand offered for sale.

*Second*, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

*Third*, with the fee charged by the State for a certificate, which is five dollars for each of the following articles, nitrogen, phosphoric acid and potassium oxide, guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they

desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates should be addressed to the Director of the Massachusetts State Agricultural Experiment Station.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing resources. Requests for analyses of substances — as fodder articles, fertilizers, etc. — coming through officers of agricultural societies and farmers' clubs within the State will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without a charge for the services rendered. Application of private parties for analyses of substances, free of charge, will receive a careful consideration whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

## 3. LIST OF MANUFACTURERS AND DEALERS WHO HAVE SECURED CERTIFICATES FOR THE SALE OF COMMERCIAL FERTILIZERS IN THIS STATE DURING THE PAST YEAR (MAY 1, 1893, TO MAY 1, 1894) AND THE BRANDS LICENSED BY EACH.

Allison, Stroup & Co., New York, N. Y. : —
- Odorless Phosphate.
- Canada Wood Ashes.

Ames Fertilizer Company, Peabody, Mass. : —
- Plymouth Rock Brand.
- Special Potato Fertilizer.
- Pure Fine Bone.

H. J. Baker & Bro., New York, N. Y. : —
- "A A" Ammoniated Superphosphate.
- Special Potato Manure.
- Special Grass Manure.
- Special Tobacco Manure.
- Special Corn Manure.
- Pure Ground Bone.

C. A. Bartlett, Worcester, Mass. : —
- Ground Bone.
- Animal Fertilizer.

Bowker Fertilizer Company, Boston, Mass. : —
- Stockbridge Special Manures.
- Bowker's Hill and Drill Phosphate.
- Bowker's Farm and Garden Phosphate, or Ammoniated Bone.
- Bowker's Lawn and Garden Dressing.
- Bowker's Fish and Potash.
- Bowker's Potato and Vegetable Manure.
- Bowker's Sure Crop Bone Phosphate.
- Gloucester Fish and Potash.
- Bowker's Dried Ground Fish.
- Bowker's Fresh Ground Bone.
- Nitrate of Soda.
- Dried Blood.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulphate of Potash.

Bradley Fertilizer Company, Boston, Mass. : —
Bradley's XL Phosphate.
BD Sea Fowl Guano.
Bradley's Potato Manure.
Original Coe's Superphosphate.
Bradley's Complete Manures.
Breck's Fertilizer.
High-grade Tobacco Manure.
Bradley's English Lawn Fertilizer.
Farmer's New Method Fertilizer.
Bradley's Fish and Potash.
Bradley's Pure Fine-ground Bone.
Dissolved Bone-black.
Nitrate of Soda.
Sulphate of Ammonia.
Muriate of Potash.
Sulphate of Potash.

W. J. Brightman & Co., Tiverton, R. I. : —
Dry Ground Fish.
Fish and Potash.
Superphosphate.

Bryant & Brett, New Bedford, Mass. : —
Ground Bone.

Burgess & Roy, South Attleborough, Mass. : —
Animal Fertilizer.

Joseph Church & Co., Tiverton, R. I. : —
Special Fertilizer (B Brand).
Standard Fertilizer (C Brand).
Fish and Potash (D Brand).

Clark's Cove Fertilizer Company, Boston, Mass. : —
Bay State Fertilizer.
Bay State Fertilizer, G. G.
Great Planet " A " Manure.
King Philip Guano.
Potato and Tobacco Fertilizer.
Fish and Potash.

Clark's Cove Fertilizer Company, Boston, Mass. — *Concluded.*
Tobacco Fertilizer.
Ground Bone.
Potato Manure.
Muriate of Potash.
Nitrate of Soda.
Sulphate of Potash.

Cleveland Dryer Company, Boston, Mass. : —
Cleveland Superphosphate.
Cleveland Potato Phosphate.
Cleveland Corn and Grain Phosphate.
Cleveland Fertilizer.

Cleveland Linseed Oil Company, Cleveland, O. : —
Tobacco Fertilizer.

E. Frank Coe, New York, N. Y. : —
Alkaline Bone Phosphate.
Special Tobacco Fertilizer.
Potato Fertilizer.
Ammoniated Bone Superphosphate.
Fish Guano and Potash.
Gold Brand Excelsior Guano.
Red Brand Excelsior Guano.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
Ammoniated Bone Superphosphate.
Potato, Tobacco and Hop Phosphate.
Special Potato Manure.
Ammoniated Wheat and Corn Phosphate.
New Rival Ammoniated Superphosphate.
Ammoniated Practical Superphosphate.
Vegetable Bone Superphosphate.
Lawn Fertilizer.
Pure Ground Bone.
Ground Bone Meal.

Cumberland Bone Company, Portland, Me. : —
Cumberland Superphosphate.
Cumberland Potato Fertilizer.
Cumberland Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I.: —
Darling's Animal Fertilizer.
Darling's Extra Bone Phosphate.
Darling's Potato and Root Crop Fertilizer.
Darling's Lawn and Garden Fertilizer.
Darling's Tobacco Grower.
Darling's Pure Fine Bone.
Darling's Pure Dissolved Bone.

John C. Dow & Co., Boston, Mass.: —
Dow's Ground Bone Fertilizer.
Dow's Nitrogenous Superphosphate.
Dow's Ground Bone.

Forest City Wood Ash Company, Boston, Mass.: —
Canada Unleached Hardwood Ashes.

William E. Fyfe & Co., Clinton, Mass.: —
Star Brand Canada Wood Ashes.

Great Eastern Fertilizer Company, Rutland, Vt.: —
Great Eastern General, for Grass and Grain.
Great Eastern Vegetable, Vine and Tobacco Fertilizer.
Great Eastern General, Oats, Buckwheat and Seeding-down Phosphate.

James J. H. Gregory & Son, Marblehead, Mass.: —
Gregory's Combination Fertilizer.
Gregory's Corn Fertilizer.
Gregory's Potato Fertilizer.

Hargraves' Manufacturing Company, Fall River, Mass.: —
Ground Bone.

Edmund Hersey, Hingham, Mass.: —
Fine-ground Bone.

Thomas Hersom & Co., New Bedford, Mass.: —
Meat and Bone.
Bone Meal.

John G. Jefferds, Worcester, Mass. : —
  Animal Fertilizer.
  Potato Manure.
  Ground Bone.

John Joynt, St. Helens, Ont. : —
  Canada Hardwood Unleached Ashes.

F. R. Lalor, Dunnville, Ont. : —
  Canada Hardwood Ashes (Maple Brand).

A. Lee & Co., Lawrence, Mass. : —
  Lawrence Fertilizer.

Lowell Bone Fertilizer Company, Lowell, Mass. : —
  Lowell Bone Fertilizer.

Mapes Formula and Peruvian Guano Company, New York, N.Y. : —
  Mapes Superphosphates.
  Mapes Special Crop Manures.
  Peruvian Guanos.
  Bone Manures.
  Sulphate of Potash.

James E. McGovern, Lawrence, Mass. : —
  Ground Bone.
  West Andover Market Bone Phosphate.

Monroe, DeForest & Co., Oswego, N. Y. : —
  Hardwood Ashes.

National Fertilizer Company, Bridgeport, Conn. : —
  Chittenden's Complete Fertilizers.
  Chittenden's Universal Phosphate.
  Chittenden's Fish and Potash.
  Chittenden's Ground Bone.

Pacific Guano Company, Boston, Mass. : —
  Pacific Guano.
  Potato Manure.
  Potato and Tobacco Fertilizer.
  Fish and Potash.
  High-grade General Fertilizer.

John J. Peters, Long Island City, N. Y. : —
  Sheep Fertilizer.

Prentiss, Brooks & Co., Holyoke, Mass. : —
  Complete Manures.
  Phosphate.
  Tankage.
  Dissolved Bone-black.
  Nitrate of Soda.
  Muriate of Potash.

Preston Fertilizer Company, Greenpoint, Long Island : —
  Ammoniated Bone Superphosphate.

Quinnipiac Fertilizer Company, Boston, Mass. : —
  Quinnipiac Phosphate.
  Quinnipiac Potato Manure.
  Quinnipiac Market Garden Manure.
  Quinnipiac Corn Manure.
  Quinnipiac Fish and Potash (Crossed Fishes).
  Quinnipiac Fish and Potash (Plain).
  Quinnipiac Havana Fertilizer.
  Quinnipiac Onion Manure.
  Quinnipiac Bone Meal.
  Quinnipiac Grass Fertilizer.
  Quinnipiac Dry Ground Fish.
  Quinnipiac Potato and Tobacco Fertilizer.
  Sulphate of Potash.
  Muriate of Potash.
  Nitrate of Soda.

The Read Fertilizer Company, Syracuse, N. Y. : —
  Read's Standard Phosphate.
  H. G. Farmer's Friend.
  Fish and Potash.
  Vegetable and Vine Phosphate.

John S. Reese & Co., Baltimore, Md. : —
  New England Favorite.
  Potato Special.
  Pilgrim.
  Mayflower.
  Columbus A.

Lucien Sanderson, New Haven, Conn. : —
- Formula A.
- Formula B.
- H. G. Sulphate of Potash.
- Sulphate Potash-magnesia.
- Dry Ground Fish.
- Blood, Meat and Bone.
- Dissolved Bone-black.
- Nitrate of Soda.
- Muriate of Potash.

Edward H. Smith, Northborough, Mass. : —
- Ground Bone.

Springfield Provision Company, Brightwood, Mass. : —
- Blood, Meat and Bone.

Standard Fertilizer Company, Boston, Mass. : —
- Superphosphate.
- Standard Fertilizer.
- Potato and Tobacco Fertilizer.
- Complete Manure.
- Standard Guano.

Chas. Stevens, Napanee, Ont. : —
- "Beaver Brand" Canada Hardwood Ashes.

F. C. Sturtevant, Hartford, Conn. : —
- Sturtevant's Tobacco and Sulphur.

J. A. Tucker & Co., Boston, Mass. : —
- Original Bay State Bone Superphosphate.
- Imperial Bone Superphosphate.

Walker, Stratman & Co., Pittsburg, Pa. : —
- Potato Special.
- Tobacco Special.
- Banner Fertilizer.
- Four-fold Fertilizer.

Whittemore Bros., Wayland, Mass. : —
- Whittemore's Complete Manure.

Leander Wilcox, Mystic, Conn.: —
- Potato, Onion and Tobacco Manure.
- Ammoniated Bone Phosphate.
- H. G. Fish and Potash.
- Dry Ground Fish Guano.

Williams & Clark Fertilizer Company, Boston, Mass.: —
- Ammoniated Bone Superphosphate.
- Universal Ammoniated Dissolved Bone.
- High-grade Special.
- Lawn Dressing.
- Potato and Tobacco Manure.
- Fine Wrapper Tobacco Grower.
- Royal Bone Phosphate.
- Prolific Crop Producer.
- Potato Phosphate.
- Corn Phosphate.
- Grass Manure.
- Onion Manure.
- Pure Bone Meal.
- Dry Ground Fish.
- Fish and Potash.
- Dissolved Bone-black.
- Nitrate of Soda.
- Muriate of Potash.
- Sulphate of Potash.

## 4. ANALYSES OF LICENSED FERTILIZERS COLLECTED DURING 1893 IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

| Laboratory Number. | NAME OF BRAND. | NAME OF MANUFACTURER. | Sampled at— |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 9 | Potato Phosphate, | Williams & Clark Fertilizer Company, Boston, Mass., | Hadley. |
| 10 | Dry Ground Fish, | Williams & Clark Fertilizer Company, Boston, Mass., | Hadley. |
| 12 | XL Superphosphate of Lime, | Bradley Fertilizer Company, Boston, Mass., | Springfield. |
| 13 | Potato Phosphate, | Williams & Clark Fertilizer Company, Boston, Mass., | Springfield. |
| 14 | Potato Manure, | Quinnipiac Fertilizer Company, Boston, Mass., | Springfield. |
| 19 | Blood, Meat and Bone, | Springfield Provision Company, Brightwood, Mass., | Brightwood. |
| 40 | XL Superphosphate of Lime, | Bradley Fertilizer Company, Boston, Mass., | Worcester. |
| 55 | Castor Pomace, | H. J. Baker & Bro., New York, N. Y., | Amherst. |
| 64 | Sheep Fertilizer, | John J. Peters, Long Island City, N. Y., | Boston. |
| 69 | Canada Unleached Wood Ashes, | Forest City Wood Ash Company, London, Ont., | Boston. |
| 71 | Complete Corn and Grain Manure, | Bradley Fertilizer Company, Boston, Mass., | Boston. |
| 73 | Pacific Guano, | Pacific Guano Company, Boston, Mass., | Newburyport. |
| 100 | King Philip Guano, | Clark's Cove Fertilizer Company, Boston, Mass., | Lawrence. |
| 102 | Potato Manure, | Quinnipiac Fertilizer Company, Boston, Mass., | Fitchburg. |
| 106 | Potato, Hop and Tobacco Phosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Lowell. |

| | | | |
|---|---|---|---|
| 108 | Vegetable, Vine and Tobacco Fertilizer, | Great Eastern Fertilizer Company, Rutland, Vt., | Mansfield. |
| 110 | High-grade Potato Fertilizer, | E. Frank Coe, New York, N. Y., | Palmer. |
| 150 | Potato, Hop and Tobacco Phosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 171 | Pilgrim Fertilizer, | John S. Reese & Co., Baltimore, Md., | Pittsfield. |
| 225 | Canada Unleached Wood Ashes, | Forest City Wood Ash Company, London, Ont., | Amherst. |
| 226 | South Carolina Floats, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| 227 | Cotton-seed Meal, | (Agent) S. P. Puffer, North Amherst, Mass., | North Amherst. |
| 228 | Linseed Meal, | Cleveland Linseed Oil Company, Cleveland, Ohio, | Amherst. |
| 229 | Odorless Phosphate, | Pottstown Iron Company, Pottstown, Penn., | Amherst. |
| | *Chemicals.* | | |
| 50 | High grade Sulphate of Potash, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| 52 | Sulphate of Ammonia, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| 53 | Dried Blood, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| 57 | Nitrate of Potash, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| | *Bones.* | | |
| 49 | Steamed Fine-ground Bone, | Edward H. Smith, Northborough, Mass., | Amherst. |
| 81 | Pure Ground Bone, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Fitchburg. |
| 148 | Ground Bone, | Edmund Hersey, Hingham, Mass., | Amherst. |
| 155 | Pure Ground Bone, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | Moisture. | NITROGEN IN ONE HUNDRED POUNDS. |  | PHOSPHORIC ACID IN ONE HUNDRED POUNDS. |  |  |  |  |  |  | POTASSIUM OXIDE IN ONE HUNDRED POUNDS. |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  | TOTAL. |  | AVAILABLE. |  |  |  |
|  |  |  | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
|  | *Compound Fertilizers.* |  |  |  |  |  |  |  |  |  |  |  |  |
| 9<br>13 | Potato Phospate, | 14.56 | 2.80 | 2.47—3.30 | 4.39 | 2.07 | 1.77 | 8.23 | 7—11 | 6.46 | 6—9 | 6.03 | 5—6 |
| 10 | Dry Ground Fish, | 10.62 | 8.86 | 7.41—9.06 | 1.11 | 3.68 | 2.05 | 6.84 | 7—9 | 4.79 | - | - | - |
| 12<br>40 | XL Superphosphate of Lime, | 14.85 | 2.78 | 2.50—3.25 | 7.55 | 2.05 | 2.17 | 11.77 | 11—14 | 9.60 | 9—11 | 2.45 | 2—3 |
| 14<br>102 | Potato Manure, | 14.70 | 2.33 | 2.47—3.30 | 4.30 | 1.84 | 1.74 | 7.88 | 7—11 | 6.14 | 6—9 | 5.22 | 5—6* |
| 19 | Blood, Meat and Bone, | 11.68 | 8.04 | 7—8 | .36 | 5.17 | 3.58 | 9.11 | 9.5—10.5 | 5.53 | - | - | - |
| 55 | Castor Pomace, | 10.08 | 5.60 | 5—6 | - | - | - | 2.26 | - | - | - | 3.40 | - |
| 64 | Sheep Fertilizer, | 29.07 | 2.01 | 1.65 | - | - | - | 1.22 | 1.20 | - | - | 2.38 | 1.70 |
| 69<br>225 | Canada Unleached Wood Ashes, | 10.84 | - | - | - | - | - | 1.38 | 1.5—2.5 | - | - | 6.25 | 4.5—8 |
| 71 | Complete Corn and Grain Manure, | 10.60 | 3.02 | 3.30—4.12 | 2.94 | 10.31 | 2.61 | 15.86 | 13—15 | 13.25 | 12—14 | 5.50 | 3—4 |
| 73 | Pacific Guano, | 17.52 | 2.22 | 2.25—3 | 6.45 | 3.21 | .70 | 10.36 | 10.50—16 | 9.66 | 8.5—12 | 2.00 | 2—3 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | King Philip Guano, | 17.69 | 1.23 | 1.03—1.64 | 6.40 | 2.30 | 1.02 | 9.72 | 9—12 | 8.70 | 8—10 | 2.13 | | 2—3 | |
| 106<br>150 | Potato, Hop and Tobacco Phosphate, | 14.08 | 2.02 | 2.1—3.2 | 7.68 | 1.66 | 1.41 | 10.75 | 10—12 | 9.34 | 10—12 | 3.53 | | 3.2—4.3* | |
| 108 | Vegetable, Vine and Tobacco Fertilizer, | 14.74 | 2.28 | 2.06—2.88 | 7.16 | 1.12 | .90 | 9.18 | 8—12 | 8.28 | 8—12 | 5.74 | | 6—8 | |
| 110 | High-grade Potato Fertilizer, | 11.25 | 1.75 | 2—2.5 | 5.88 | 1.90 | 1.74 | 9.52 | 10—13 | 7.78 | 8—10 | 5.27 | | 6—7* | |
| 171 | Pilgrim Fertilizer, | 17.34 | .89 | 1.23—2.70 | 3.45 | 4.10 | 1.02 | 8.57 | 7.5—10.5 | 7.55 | 6.5—8 | 3.36 | | 3—4 | |
| 226 | South Carolina Floats, | .83 | - | - | - | 2.33 | 21.06 | 23.39 | - | 2.33 | - | - | | - | |
| 227 | Cotton-seed Meal, | 8.65 | 6.50 | - | - | - | - | 3.17 | - | - | - | 2.25 | | - | |
| 228 | Linseed Meal, | 10.43 | 5.91 | 5.80—6.20 | - | - | - | 1.95 | 1.98—2.20 | - | - | 1.08 | | 1.30—1.50 | |
| 229 | Odorless Phosphate, | .63 | - | - | - | - | - | 18.42 | 18.00 | - | - | - | | - | |
| | *Chemicals.* | | | | | | | | | | | | | | |
| 50 | High-grade Sulphate of Potash, | 1.36 | - | - | - | - | - | - | - | - | - | 50.20 | | 48—52 | |
| 52 | Sulphate of Ammonia, | 1.50 | 19.59 | 19.78—20.60 | - | - | - | - | - | - | - | - | | - | |
| 53 | Dried Blood, | 7.69 | 10 | 9.06—10.71 | - | - | - | 4.02 | - | - | - | - | | - | |
| 57 | Nitrate of Potash, | 1.80 | 12.79 | 12.57 | - | - | - | - | - | - | - | 45.04 | | 41.88 | |
| | | | | | | | | | | | | Mechanical Analysis. | | | |
| | *Bones.* | | | | | | | | | | | Fine. | Med. Fine. | Med. | Coarse Med. |
| 49 | Steamed Fine-ground Bone, | 4.85 | 4.02 | 4.02 | .29 | 9.77 | 12.90 | 22.96 | 22.96 | 10.06 | 10.06 | 40.70 | 41.24 | 18.06 | - |
| 81<br>155 | Pure Ground Bone, | 5.82 | 3.89 | 2.9—3.7 | .13 | 10.61 | 15.36 | 26.10 | 25.00 | 10.74 | - | 36.32 | 30.00 | 25.50 | 8.18 |
| 148 | Ground Bone, | 3.34 | 3.13 | 3—4 | .13 | 13.95 | 10.36 | 24.44 | 19.25 | 14.08 | - | 51.72 | 14.89 | 20.91 | 12.48 |

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* Sulphate of potash, the source of potash.

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | NAME OF MANUFACTURER. | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 1 | Potato Special, | Walker, Stratman & Co., Pittsburg, Pa., | Amherst. |
| 11 | Hampden Lawn Dressing, | Bradley Fertilizer Company, Boston, Mass., | Springfield. |
| 17 | Ammoniated Bone Superphosphate, | Williams & Clark, Boston, Mass., | Springfield. |
| 18 | Fish and Potash (Crossed Fish Brand), | Quinnipiac Fertilizer Company, Boston, Mass., | Springfield. |
| 28 | Complete Manure for Potatoes and Root Crops, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 32 | Stockbridge Complete Manure for Potatoes and Vegetables, | Bowker Fertilizer Company, Boston, Mass., | Springfield. |
| 34 | Fish and Potash (D Brand), | Joseph Church & Co., Tiverton, R. I., | Springfield. |
| 36 | Complete Potato Manure, | H. J. Baker & Bro., New York, N. Y., | Springfield. |
| 42 | Animal Fertilizer, | J. G. Jefferds, Worcester, Mass., | Worcester. |
| 65 | Complete Animal Fertilizer, | C. A. Bartlett, Worcester, Mass., | Boston. |
| 76 | English Lawn Dressing, | Bradley Fertilizer Company, Boston, Mass., | Lowell. |
| 77 | Bay State Fertilizer, | Clark's Cove Fertilizer Company, Boston, Mass., | Lawrence. |
| 80 | Lawrence Fertilizer, | A. Lee & Co , Boston, Mass., | Lawrence. |
| 82 | Animal Fertilizer, | L. B. Darling Fertilizer Company, Pawtucket, R. I., | Lowell. |
| 86 | Special Potato Manure, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Fitchburg. |
| 90 | Ammoniated Bone Superphosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Lowell. |
| 98 | English Lawn Dressing, | Bradley Fertilizer Company, Boston, Mass., | Fitchburg. |

| | | | |
|---|---|---|---|
| 129 | Ammoniated Bone Superphosphate, | Williams & Clark, Boston, Mass., | Dighton. |
| 141 | Bay State Fertilizer, | Clark's Cove Fertilizer Company, Boston, Mass., | Dighton. |
| 147 | Fish and Potash (D Brand), | Joseph Church & Co., Tiverton, R. I., | Taunton. |
| 153 | Special Potato Manure, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 157 | Ammoniated Bone Superphosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 199 | Special Potato Manure, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | North Adams. |
| 201 | Potato Special, | Walker, Stratman & Co., Pittsburg, Pa., | Leeds. |
| | *Bones.* | | |
| 24 | Fine-ground Bone, | Gilbert E. Holmes, Worcester, Mass., | Worcester. |
| 83 | Ground Bone Meal, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Fitchburg. |
| 124 | Ground Bone, | Hargraves Manufacturing Company, Fall River, Mass., | Fall River. |
| 127 | Fine-ground Bone, | Bryant & Brett, New Bedford, Mass., | New Bedford. |
| 128 | Pure Bone Meal, | Thomas Hersom & Co., New Bedford, Mass , | New Bedford. |
| 154 | Ground Bone Meal, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 215 | Fine-ground Bone, | Bryant & Brett, New Bedford, Mass., | Amherst. |

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | Moisture. | NITROGEN IN ONE HUNDRED POUNDS. | | PHOSPHORIC ACID IN ONE HUNDRED POUNDS. | | | | | | | POTASSIUM OXIDE IN ONE HUNDRED POUNDS. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | TOTAL. | | AVAILABLE. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| | *Compound Fertilizers.* | | | | | | | | | | | | |
| 1<br>201 | Potato Special, | 11.70 | 1.72 | 2.47—3.30 | 5.12 | 2.54 | 5.90 | 13.56 | 12—13 | 7.66 | 10—11 | 7.01 | 5—6 |
| 11 | Hampden Lawn Dressing, | 8.16 | 4.86 | 3.30—4.12 | 1.41 | 3.58 | 1.92 | 6.91 | 7—9 | 4.99 | 6—8 | 3.13 | 2—3 |
| 17<br>129 | Ammoniated Bone Superphosphate, | 12.98 | 2.47 | 2.47—3.30 | 7.55 | 2.94 | 1.28 | 11.77 | 10—13 | 10.49 | 9—11 | 2.11 | 2—3 |
| 18 | Fish and Potash (Crossed Fish Brand), | 21.05 | 4.90 | 3.30—4.12 | 2.35 | 2.55 | 2.26 | 7.16 | 5—8 | 4.90 | 3—5 | 5.60 | 3—5 |
| 28 | Complete Manure for Potatoes and Root Crops, | 9.75 | 3.30 | 4.12—4.94 | 3.97 | 2.05 | 3.04 | 9.06 | 6—8 | 6.02 | 5—6 | 8.76 | 8—10 |
| 32 | Stockbridge Complete Manure for Potatoes and Vegetables, | 10.34 | 3.31 | 3.25—4.25 | 4.95 | 3.15 | 4.08 | 12.18 | 8—10 | 8.10 | 7—8 | 6.97 | 5—6 |
| 34<br>147 | Fish and Potash (D Brand), | 21.40 | 2.58 | 2.47—3.30 | 2.81 | 3.43 | 1.33 | 7.57 | 7.5—8.5 | 6.24 | - | 1.84 | 2—3 |
| 36 | Complete Potato Manure, | 8.69 | 3.70 | 3.30 | 3.45 | 2.10 | 1.84 | 7.39 | - | 5.55 | 5.75 | 9.25 | 10 |
| 42 | Animal Fertilizer, | 10.67 | 2.25 | 2.47—3.30 | 6.04 | 1.76 | 8.17 | 15.97 | 16—18 | 7.80 | 11—13 | 3.69 | 2.5—3.5 |
| 65 | Complete Animal Fertilizer, | 4.44 | 5.78 | 3.30—4.12 | .95 | 6.57 | 5.17 | 12.69 | 16—18 | 7.52 | - | 7.12 | 7—8 |
| 76<br>98 | English Lawn Dressing, | 8.20 | 4.78 | 4.95—5.78 | 1.28 | 3.66 | 2.30 | 7.24 | 6—8 | 4.94 | 5—7 | 2.86 | 2.5—3.5* |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 77<br>141 | Bay State Fertilizer, . . . . . . . | 14.80 | 2.42 | 2.47—3.30 | 6.72 | 4.16 | 1.94 | 12.82 | 10—14 | 10.88 | 9—12 | 2.28 | | 2—3* | |
| 80 | Lawrence Fertilizer, . . . . . . . | 12.94 | 2.63 | 2.06—2.26 | 7.16 | 2.11 | 1.48 | 10.75 | 10—12 | 9.27 | - | 2.70 | | 2—3 | |
| 82 | Animal Fertilizer, . . . . . . . | 12.92 | 2.99 | 3—4.5 | 3.48 | 3.73 | 1.87 | 9.08 | 10—12 | 7.21 | 6—8 | 5.83 | | 4—5 | |
| 86<br>153<br>199 | Special Potato Manure, . . . . . . | 15.12 | 3.37 | 3.71—4.57 | 6.60 | 1.92 | .84 | 9.36 | 8—9 | 8.52 | 8—9.5 | 5.51 | | 5.4—6.4* | |
| 90<br>157 | Ammoniated Bone Superphosphate, . . | 13.47 | 2.92 | 2.8—3.7 | 6.81 | 2.60 | 1.59 | 11.00 | 10—12 | 9.41 | 10—12 | 1.08 | | 1—2* | |
| | | | | | | | | | | | | Mechanical Analysis. | | | |
| | *Bones.* | | | | | | | | | | | | | | |
| 24 | Fine-ground Bone, . . . . . . . | 9.15 | 2.90 | 2.50—3.50 | .20 | 7.90 | 12.57 | 20.67 | 22—24 | 8.10 | - | Fine.<br>16.64 | Med. Fine.<br>23.43 | Med.<br>49.73 | Coarse Med.<br>10.20 |
| 83<br>154 | Ground Bone Meal, . . . . . . . | 13.15 | 1.21 | 2—3 | .32 | 10.49 | 17.00 | 27.81 | 25—28 | 10.81 | - | 17.57 | 47.70 | 25.47 | 9.26 |
| 124 | Ground Bone, . . . . . . . . | 13.80 | 3.52 | 2.5—2.8 | .51 | 8.19 | 12.54 | 21.24 | 25—27 | 8.70 | - | 17.86 | 19.86 | 18.56 | 43.72 |
| 127<br>215 | Fine-ground Bone, . . . . . . . | 7.61 | 2.78 | 2.50 | .26 | 8.44 | 16.50 | 25.20 | 25.56 | 8.70 | - | 38.43 | 32.95 | 19.17 | 9.45 |
| 128 | Pure Bone Meal, . . . . . . . . | 4.84 | 1.75 | 2.00 | .38 | 10.11 | 19.57 | 30.06 | 29.21 | 10.49 | 9.40 | 74.15 | 19.04 | 6.81 | - |

* Sulphate of potash, the source of potash.

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | NAME OF MANUFACTURER. | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 91 | Quinnipiac Phosphate, | Quinnipiac Fertilizer Company, Boston, Mass., | Fitchburg. |
| 96 | Cumberland Superphosphate, | Cumberland Bone Company, Portland, Me., | Lowell. |
| 105 | Manure for Light Soils, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Fitchburg. |
| 111 | Alkaline Bone, | E. Frank Coe, New York, N. Y., | Mansfield. |
| 112 | Cleveland Superphosphate, | Cleveland Dryer Company, Boston, Mass., | So. Framingham. |
| 118 | Eclipse Phosphate, | Bradley Fertilizer Company, Boston, Mass., | Palmer. |
| 119 | Potato Fertilizer, | J. J. H. Gregory & Son, Marblehead, Mass., | Amherst. |
| 123 | Market Garden Manure, | Quinnipiac Fertilizer Company, Boston, Mass , | Fall River. |
| 130 | Complete Corn Manure, | H. J. Baker & Bro., New York, N. Y., | Fall River. |
| 131 | Good Brand Excelsior Guano, | E. Frank Coe, New York, N. Y., | Dighton. |
| 136 | Potato and Root Crop Manure, | L. B. Darling Fertilizer Company, Pawtucket, R. I., | Fall River. |
| 138 | Fish and Potash, | W. J. Brightman & Co., Tiverton, R. I., | Fall River. |
| 140 | Nitrogenous Superphosphate, | J. C. Dow & Co., Boston, Mass., | Dighton. |
| 166 | High-grade Tobacco Manure, | Bradley Fertilizer Company, Boston, Mass., | Greenfield. |
| 169 | Standard Phosphate, | Read Fertilizer Company, Syracuse, N. Y., | Pittsfield. |
| 173 | Ammoniated Bone Superphosphate, | Preston's Fertilizer Company, Greenpoint, L. I., | Williamstown. |
| 184 | Dry Ground Fish, | Bradley Fertilizer Company, Boston, Mass., | Greenfield. |

| | | | |
|---|---|---|---|
| 185 | Fine Wrapper Tobacco Grower, | Williams & Clark Fertilizer Company, Boston, Mass., | Greenfield. |
| 190 | Standard Potato and Tobacco Fertilizer, | Standard Fertilizer Company, Boston, Mass., | Greenfield. |
| 193 | Tobacco Starter, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Greenfield. |
| 195 | High-grade Special, | Williams & Clark Fertilizer Company, Boston, Mass., | Greenfield. |
| 205 | Fish and Potash, | National Fertilizer Company, Bridgeport, Conn., | Hadley. |
| 214 | Tobacco Fertilizer, | National Fertilizer Company, Bridgeport, Conn., | Hadley. |
| 216 | Potato, Onion and Tobacco Fertilizer, | Leander Wilcox, Mystic, Conn., | Amherst. |
| 217 | Ammoniated Bone Superphosphate, | Leander Wilcox, Mystic, Conn., | Amherst. |
| 223 | Tobacco Starter, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | South Deerfield. |
| 224 | Havana Tobacco Fertilizer, | Quinnipiac Fertilizer Company, Boston, Mass., | South Deerfield. |
| 234 | Tobacco Fertilizer, | Clark's Cove Fertilizer Company, Boston, Mass., | Agawam. |

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | Moisture. | NITROGEN IN ONE HUNDRED POUNDS. | | PHOSPHORIC ACID IN ONE HUNDRED POUNDS. | | | | | | | POTASSIUM OXIDE IN ONE HUNDRED POUNDS. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | TOTAL. | | AVAILABLE. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| | *Compound Fertilizers.* | | | | | | | | | | | | |
| 91 | Quinnipiac Phosphate, . . . . . . | 14.41 | 2.56 | 2.47—3.30 | 7.14 | 2.21 | 1.45 | 10.80 | 10—14 | 9.35 | 9—12 | 2.32 | 2—3* |
| 96 | Cumberland Superphosphate, . . . . . | 16.43 | 2.79 | 2.06—2.88 | 6.22 | 2.91 | 2.43 | 11.56 | 10—12 | 9.13 | 8—10 | 2.01 | 2—3* |
| 105 | Manure for Light Soils, . . . . . . | 10.70 | 4.90 | 4.04—6.59 | 5.19 | 2.77 | 2.29 | 10.25 | 8—10 | 7.96 | 6—8 | 7.38 | 6—8 |
| 111 | Alkaline Bone, . . . . . . . . . | 11.13 | 1.03 | 1—1.5 | 7.42 | .58 | 2.84 | 10.84 | 9—12 | 8.00 | 7—9 | 2.59 | 1.62—2.16* |
| 112 | Cleveland Superphosphate, . . . . . | 17.77 | 2.09 | 2.05—2.85 | 7.16 | 2.05 | 1.51 | 10.72 | 11—14 | 9.21 | 9—11 | 3.31 | 2—3* |
| 118 | Eclipse Phosphate, . . . . . . . | 13.60 | 2.54 | 1—2 | 3.27 | 6.40 | 1.49 | 11.16 | 12—15 | 9.67 | 10—12 | 2.84 | 1.5—2.5* |
| 119 | Potato Fertilizer, . . . . . . . | 7.65 | 4.09 | 4.12—4.94 | 2.70 | 2.42 | 2.30 | 7.42 | 7 | 5.12 | 5—6 | 12.70 | 13* |
| 123 | Market Garden Manure, . . . . . . | 12.48 | 3.08 | 3.30—4.12 | 5.28 | 2.80 | .90 | 8.98 | 9—13 | 8.08 | 8—11 | 7.13 | 7—8* |
| 130 | Complete Corn Manure, . . . . . . | 11.31 | 3.98 | 3.71 | 3.43 | 2.84 | 1.89 | 8.16 | - | 6.27 | 5 | 7.10 | 7.5 |
| 131 | Gold Brand Excelsior Guano, . . . . . | 8.92 | 2.23 | 2.5—3.5 | 6.60 | 2.00 | 2.56 | 11.16 | 9—13 | 8.60 | 8—11 | 8.21 | 6—8* |
| 136 | Potato and Root Crop Manure, . . . . . | 12.00 | 2.61 | 3—4 | 4.71 | 3.45 | 5.12 | 13.28 | 10—12 | 8.16 | 6—8 | 6.72 | 7—8 |
| 138 | Fish and Potash, . . . . . . . . | 28.81 | 3.64 | 3.71 | 2.17 | 2.66 | .90 | 5.73 | 5—7 | 4.83 | - | 5.26 | 5—6 |
| 140 | Nitrogenous Superphosphate, . . . . . | 16.69 | 3.11 | 2.06—2.88 | 5.76 | 3.32 | 1.28 | 10.36 | - | 9.08 | 8—10 | 3.35 | 1.89—2.52 |
| 166 | Bradley's High grade Tobacco Manure, . . | 6.18 | 5.81 | 5.77—6.59 | 1.84 | 2.41 | 1.71 | 5.96 | 4—5 | 4.25 | - | 14.08 | 10.80—12.42* |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 169 | Standard Phosphate, | 14.17 | 1.06 | .82—1.65 | 3.10 | 6.65 | .23 | 9.98 | 10—12 | 9.75 | 8—10 | 4.17 | 4—6* |
| 173 | Ammoniated Bone Superphosphate, | 9.20 | 3.65 | 2.47—3.30 | 1.56 | 4.58 | 1.89 | 8.03 | 8—11 | 6.14 | - | 3.09 | 2—3 |
| 184 | Dry Ground Fish, | 15.63 | 8.33 | 7.41—9.06 | 1.28 | 2.95 | 2.04 | 6.27 | 7—9 | 4.23 | - | - | - |
| 185 | Fine Wrapper Tobacco Grower, | 6.30 | 5.84 | 5.77—6.59 | 1.41 | 2.82 | 2.81 | 7.04 | 6—9 | 4.23 | 5—7 | 9.96 | 10—12 |
| 190 | Standard Potato and Tobacco Fertilizer, | 13.86 | 1.83 | 2.05—2.88 | 7.01 | 1.33 | 2.42 | 10.76 | 9—13 | 8.34 | - | 3.69 | 3—4 |
| 193<br>223 | Tobacco Starter, | 10.35 | 2.85 | 2.47—3.30 | 6.42 | 2.46 | 4.22 | 13.10 | 12—16 | 8.88 | - | 3.90 | 2.5—3.5 |
| 195 | High-grade Special, | 12.45 | 3.66 | 3.71—4.11 | 7.09 | .94 | .59 | 8.62 | 8—11 | 8.03 | 7—9 | 7.83 | 7—9 |
| 205 | Fish and Potash, | 7.48 | 2.91 | 3.30—4.12 | 2.15 | 2.00 | 3.63 | 7.78 | 6—8 | 4.15 | - | 5.64 | 5—6 |
| 214 | Tobacco Fertilizer, | 11.32 | 4.53 | 3.30—4.94 | 7.65 | 1.14 | .60 | 9.39 | 10—12 | 8.79 | 8—10 | 5.07 | 5.40—6.48* |
| 216 | Potato, Onion and Tobacco Manure, | 14.44 | 3.35 | 3.25—4.25 | 4.86 | 2.20 | 1.79 | 8.85 | 8—9 | 7.06 | 7—8 | 6.72 | 6—7 |
| 217 | Ammoniated Bone Superphosphate, | 15.53 | 2.87 | 2.5—3.5 | 3.74 | 2.43 | 1.74 | 7.91 | 7—8 | 6.17 | 6—7 | 5.72 | 5—6 |
| 224 | Havana Tobacco Fertilizer, | 6.10 | 6.16 | 5.77—6.59 | 1.70 | 2.27 | 2.49 | 6.46 | 6—9 | 3.97 | 5—7 | 6.68 | 10—12* |
| 234 | Tobacco Fertilizer, | 5.60 | 6.38 | 5.77—6.59 | 1.41 | 2.94 | 3.45 | 7.80 | - | 4.35 | 5—7 | 10.37 | 10—12 |

* Sulphate of potash, the source of potash

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | NAME OF MANUFACTURER. | Sampled at— |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 3 | Banner Fertilizer, | Walker, Stratman & Co., Pittsburg, Pa., | Amherst. |
| 5 | Connecticut Wrapper Fertilizer, "Pinney Formula," | Cleveland Linseed Oil Company, Cleveland, Ohio, | Amherst. |
| 29 | Tankage, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 45 | Vegetable Manure, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Worcester. |
| 46 | Complete Manure for Potatoes and Vegetables, | Bradley Fertilizer Company, Boston, Mass., | Worcester. |
| 48 | Potato Manure, | J. G. Jefferds, Worcester, Mass., | Worcester. |
| 62 | Breck's Lawn and Garden Dressing, | Bradley Fertilizer Company, Boston, Mass., | Boston. |
| 72 | Fruit and Vine Manure, | Mapes Formula and Peruvian Guano Company, New York, N. Y, | Boston. |
| 75 | West Andover Market Bone Phosphate, | J. E. McGovern, West Andover, Mass., | Lawrence. |
| 85 | Tobacco and Potato Fertilizer, | Clark's Cove Fertilizer Company, Boston, Mass., | Lawrence. |
| 87 | Lawn Dressing, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Fitchburg. |
| 94 | Sure Crop Bone Phosphate, | Bowker Fertilizer Company, Boston, Mass., | Amesbury. |
| 97 | Cumberland Potato Fertilizer, | Cumberland Bone Phosphate Company, Portland, Me., | Lowell. |
| 101 | Corn Manure, | Quinnipiac Fertilizer Company, Boston, Mass., | Fitchburg. |
| 103 | Farm and Garden Phosphate, | Bowker Fertilizer Company, Boston, Mass., | Fitchburg. |
| 109 | Fertillzer for Grass and Grain, | Great Eastern Fertilizer Company, Rutland, Vt., | Mansfield. |
| 117 | Ammoniated Bone Superphosphate, | E. Frank Coe, New York, N. Y., | Palmer. |

| | | | |
|---|---|---|---|
| 145 | Ammoniated Bone Superphosphate, | E. Frank Coe, New York, N. Y., | Dighton. |
| 152 | Lawn Dressing, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 160 | West Andover Market Bone Phosphate, | J. E. McGovern, West Andover, Mass., | Amherst. |
| 198 | Ammoniated Bone Superphosphate, | E. Frank Coe, New York, N. Y., | Williamstown. |
| 207 | Banner Fertilizer, | Walker, Stratman & Co., Pittsburg, Pa., | Leeds. |
| 222 | Connecticut Wrapper Fertilizer, " Pinney Formula," | Cleveland Linseed Oil Company, Cleveland, Ohio, | Amherst. |
| | *Bones.* | | |
| 26 | Pure Raw Ground Bone, | H. J. Baker & Bro., New York, N. Y., | Springfield. |
| 67 | Fine-ground Bone, | Bradley Fertilizer Company, Boston, Mass., | Boston. |
| 70 | Pure Fine-ground Bone, | C. A. Bartlett, Worcester, Mass., | Boston. |
| 88 | Fine-ground Bone, | L. B. Darling Fertilizer Company, Pawtucket, R. I., | Newburyport. |
| 113 | Fine-ground Bone, | Bradley Fertilizer Company, Boston, Mass., | Palmer. |
| 126 | Meat and Bone, | Thomas Hersom & Co., New Bedford, Mass., | New Bedford. |
| 146 | White Oak Pure Ground Bone, | Clark's Cove Fertilizer Company, Boston, Mass., | Dighton. |
| 170 | Quinnipiac Pure Ground Bone, | Quinnipiac Fertilizer Company, Boston, Mass., | Williamstown. |

### 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | Moisture. | NITROGEN IN ONE HUNDRED POUNDS. | | PHOSPHORIC ACID IN ONE HUNDRED POUNDS. | | | | | | | POTASSIUM OXIDE IN ONE HUNDRED POUNDS. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | TOTAL. | | AVAILABLE. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| | *Compound Fertilizers.* | | | | | | | | | | | | |
| 3<br>207 | Banner Fertilizer, | 11.39 | 1.62 | 2.06—2.88 | 5.88 | 2.81 | 4.61 | 13.30 | 11—12 | 8.69 | 9—10 | 1.06 | 1—2 |
| 5<br>222 | Connecticut Wrapper Fertilizer, "Pinney Formula," | 6.53 | 4.22 | 4.50—5.25 | - | 3.84 | 1.74 | 5.58 | 5.70—6.20 | 3.84 | - | 11.20 | 10 -11* |
| 29 | Tankage, | 8.78 | 5.99 | 6.18—6.59 | - | 5.64 | 6.52 | 12.16 | 10—11 | 5.64 | - | - | - |
| 45 | Vegetable Manure, | 10.78 | 4.57 | 4.94—6.59 | 5.62 | 2.56 | 1.62 | 9.80 | 8—10 | 8.18 | 6—8 | 7.40 | 6—8 |
| 46 | Complete Manure for Potatoes and Vegetables, | 12.17 | 3.47 | 3.73—4.52 | 6.70 | 2.00 | .82 | 9.52 | 9—13 | 8.70 | 8—11 | 6.23 | 6—7 |
| 48 | Potato Manure, | 12.70 | 2.00 | 2.47—3.30 | 5.17 | 3.76 | 6.32 | 15.35 | 15—17 | 8.93 | 10—12 | 4.98 | 5—6 |
| 62 | Breck's Lawn and Garden Dressing, | 9.55 | 3.95 | 4.12—4.94 | 3.86 | 2.07 | 2.05 | 7.98 | - | 5.93 | 5—6 | 5.47 | 5—6 |
| 72 | Fruit and Vine Manure, | 8.46 | 2.42 | 1.65—2.47 | 5.73 | 2.46 | 1.48 | 9.67 | 7—9 | 8.19 | 5—7 | 12.02 | 11—12 |
| 75<br>160 | West Andover Market Bone Phosphate, | 14.92 | 2.10 | 1.50—2.50 | 4.22 | 9.64 | 1.74 | 15.60 | 13—15 | 13.86 | - | 3.92 | 2—4 |
| 85 | Tobacco and Potato Fertilizer, | 14.19 | 2.01 | 2.06—2.88 | 6.60 | 3.22 | 1.54 | 11.36 | 9—13 | 9.82 | 8—11 | 3.67 | 3—4* |
| 87<br>152 | Crocker's Lawn Dressing, | 8.53 | 3.18 | 4.12—4.94 | .27 | 9.16 | 13.87 | 23.30 | 18—20 | 9.43 | - | 3.45 | 3.24—4.32* |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 94 | Sure Crop Bone Phosphate, . . . . . | 13.55 | .95 | .82—1.65 | 7.96 | 2.76 | 3.07 | 13.79 | 10—12 | 10.72 | 5—6 | 2.09 | | 1—2* | |
| 97 | Cumberland Potato Fertilizer, . . . . . | 15.67 | 2.34 | 2.06—2.88 | 6.91 | 3.58 | 1.79 | 12.28 | 11—13 | 10.49 | 9—11 | 3.55 | | 3—4* | |
| 101 | Corn Manure, . . . . . . . . | 12.73 | 2.28 | 2.06—2.88 | 6.90 | 3.46 | 2.12 | 12.48 | 10—14 | 10.36 | 9—12 | 1.64 | | 1.50—2.50* | |
| 103 | Farm and Garden Phosphate, . . . . . | 11.11 | 2.51 | 1.65—2.47 | 6.45 | 1.74 | 3.48 | 11.67 | 12—14 | 8.19 | 8—10 | 2.39 | | 2—3* | |
| 109 | Fertilizer for Grass and Grain, . . . . . | 15.91 | 3.48 | 2.88—3.71 | 5.98 | 2.36 | 1.48 | 9.82 | – | 8.34 | 8—12 | 2.20 | | 2—4 | |
| 117<br>145<br>198 | Ammoniated Bone Superphosphate, . . . . | 10.40 | 1.88 | 2 | 7.43 | 1.24 | 3.07 | 11.74 | 11—15 | 8.67 | 9—12 | 1.75 | | 1.85* | |
| | | | | | | | | | | | | MECHANICAL ANALYSIS. | | | |
| | *Bones.* | | | | | | | | | | | Fine. | Med. Fine. | Med. | Coarse Med. |
| 26 | Pure Raw Ground Bone, . . . . . . . | 10.07 | 3.61 | 3.30—3.71 | – | 7.58 | 15.86 | 23.44 | 22—26 | 7.58 | – | 13.46 | 41.23 | 3.68 | 1.63 |
| 67<br>113 | Fine-ground Bone, . . . . . . . . | 9.21 | 3.79 | 2.50—3.25 | .18 | 5.86 | 13.44 | 19.48 | 21—23 | 6.04 | – | 40.14 | 37.42 | 22.44 | – |
| 70 | Pure Fine-ground Bone, . . . . . . | 3.55 | 2.63 | 3—4 | .51 | 9.98 | 15.61 | 26.10 | 24—26 | 10.49 | – | 55.85 | 27.73 | 16.00 | .42 |
| 88 | Fine-ground Bone, . . . . . . . . | 9.06 | 2.61 | 3.50—4.50 | .15 | 9.49 | 14.05 | 23.79 | 22—25 | 9.64 | – | 73.02 | 18.62 | 8.36 | – |
| 126 | Meat and Bone, . . . . . . . . . | 5.48 | 4.47 | 4.24 | – | 6.93 | 12.96 | 19.89 | 19.52 | 6.93 | 6.73 | – | – | – | – |
| 146 | White Oak Pure Ground Bone, . . . . . | 9.57 | 3.19 | 2.47—4.12 | – | 6.85 | 13.02 | 19.87 | 20—22 | 6.43 | – | 44.22 | 29.25 | 25.79 | .74 |
| 170 | Pure Ground Bone, . . . . . . . . | 9.31 | 3.22 | 2.47—4.12 | .26 | 7.02 | 12.54 | 19.82 | 20—25 | 7.28 | – | 51.94 | 26.49 | 21.57 | – |

* Sulphate of potash, the source of potash.

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | NAME OF MANUFACTURER. | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 2 | Tobacco Special, | Walker, Stratman & Co , Pittsburg, Pa., | Amherst. |
| 89 | Vegetable Bone Superphosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Fitchburg. |
| 120 | General Combination Fertilizer, | J. J. H. Gregory & Son, Marblehead, Mass., | Amherst. |
| 133 | Special Potato Manure, | Pacific Guano Company, Boston, Mass., | Fall River. |
| 135 | Tobacco and Sulphur Lawn Fertilizer, | F. C. Sturtevant, Hartford, Conn., | Brockton. |
| 139 | Bristol Fish and Potash, | Bowker Fertilizer Company, Boston, Mass., | Dighton. |
| 142 | Great Planet "A" Manure, | Clark's Cove Fertilizer Company, Boston, Mass , | Dighton. |
| 149 | Vegetable Bone Superphosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 163 | Ground Bone Fertilizer, | John C. Dow & Co., Boston, Mass., | Amherst. |
| 167 | Ammoniated Bone Superphosphate, | National Fertilizer Company, Bridgeport, Conn., | Pittsfield. |
| 168 | Tobacco and Sulphur Lawn Fertilizer, | F. C. Sturtevant, Hartford, Conn., | Great Barrington. |
| 172 | Complete Grass Fertilizer, | National Fertilizer Company, Bridgeport, Conn., | Pittsfield. |
| 177 | Ammoniated Bone Superphosphate, | National Fertilizer Company, Bridgeport, Conn., | Great Barrington. |
| 203 | Special Tobacco Manure, | H. J. Baker & Bro., New York, N. Y., | Northampton. |
| 209 | Ground Bone and Potash, | E. Frank Coe, New York, N. Y., | Hadley. |

| | | | |
|---|---|---|---|
| 219 | Dry Ground Fish Guano, | Leander Wilcox, Mystic, Conn., | Amherst. |
| 231 | Tobacco Special, | Walker, Stratman & Co., Pittsburg, Pa., | Northampton. |
| | *Chemicals.* | | |
| 8 | Sulphate of Potash, | Williams & Clark Fertilizer Company, Boston, Mass., | Hadley. |
| 41 | Muriate of Potash, | Bradley Fertilizer Company, Boston, Mass., | Worcester. |
| 51 | Dissolved Bone-black, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| 54 | Sulphate of Potash, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| 134 | Muriate of Potash, | Clark's Cove Fertilizer Company, Boston, Mass., | Dighton. |
| 183 | Sulphate of Potash, | Lucien Sanderson, New Haven, Conn., | Greenfield. |
| 232 | Sulphate of Potash, | Clark's Cove Fertilizer Company, Boston, Mass., | Agawam. |

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | Moisture. | NITROGEN IN ONE HUNDRED POUNDS. | | PHOSPHORIC ACID IN ONE HUNDRED POUNDS. | | | | | | | POTASSIUM OXIDE IN ONE HUNDRED POUNDS. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | TOTAL. | | AVAILABLE. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| | *Compound Fertilizers.* | | | | | | | | | | | | |
| 2<br>231 | Tobacco Special, | 10.50 | 3.46 | 2.47—3.30 | 5.42 | .60 | 6.26 | 12.28 | 10—12 | 6.02 | 8—10 | 3.22 | 3—4 |
| 89<br>149 | Vegetable Bone Superphosphate, | 11.90 | 5.03 | 5—6 | 5.08 | .88 | 1.66 | 7.62 | 6—7 | 5.96 | 6.00—7.00 | 7.76 | 6—8* |
| 120 | General Combination Fertilizer, | 7.51 | 3.14 | 3.29—4.12 | 1.84 | 3.17 | 2.97 | 7.98 | 8 | 5.01 | 6—7 | 12.17 | 12—13 |
| 133 | Special Potato Manure, | 18.84 | 2.78 | 2.47—3.30 | 4.91 | 1.82 | 2.05 | 8.78 | 7—10 | 6.73 | 5—7 | 5.10 | 5—6 |
| 135<br>168 | Tobacco and Sulphur Lawn Fertilizer, | 13.23 | 1.95 | 1.96 | - | - | - | .83 | .75 | - | - | 8.11 | 7.66 |
| 139 | Bristol Fish and Potash, | 12.55 | 2.05 | 1.60—2.50 | 6.38 | 1.62 | 4.12 | 12.12 | 8—10 | 8.00 | 5—8 | 2.60 | 2—3* |
| 142 | Great Planet "A" Manure, | 11.65 | 3.88 | 3.30—4.12 | 4.61 | 3.24 | 1.41 | 9.26 | 9—13 | 7.85 | 8—11 | 7.26 | 7—8* |
| 163 | Ground Bone Fertilizer, | 7.91 | 2.32 | 2.06—2.47 | .83 | 2.44 | 16.35 | 19.62 | 18—22 | 3.27 | - | 2.07 | 1.62—1.89* |
| 167<br>177 | Ammoniated Bone Superphosphate, | 7.42 | 1.90 | 1.65—2.47 | 1.75 | 4.67 | 5.14 | 11.56 | 9—11 | 6.42 | 7—9 | 3.88 | 2—4 |
| 172 | Complete Grass Fertilizer, | 13.27 | 4.25 | 4.12—4.94 | 7.32 | 2.15 | .61 | 10.08 | 6—8 | 9.47 | 4—6 | 6.42 | 5—7 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 203 | Special Tobacco Manure, | 6.71 | 4.54 | 4.53—5.36 | 3.38 | 1.22 | 1.23 | 5.83 | - | 4.60 | - | 11.25 | 10—12* |
| 209 | Ground Bone and Potash, | 9.71 | 1.57 | 2—2.50 | .72 | 6.06 | 8.57 | 15.35 | 10.99-11.91 | 6.78 | - | 2.71 | 2.75* |
| 219 | Dry Ground Fish Guano, | 8.51 | 8.52 | 8—10 | .59 | 3.45 | 3.51 | 7.55 | - | 6.96 | 4—6 | - | - |
| | *Chemicals.* | | | | | | | | | | | | |
| 8 | Sulphate of Potash, | 2.00 | - | - | - | - | - | - | - | - | - | 29.10 | - |
| 41 | Muriate of Potash, | 1.57 | - | - | - | - | - | - | - | - | - | 51.40 | 48—55 |
| 51 | Dissolved Bone-black, | 15.72 | - | - | 12.95 | 2.22 | .19 | 15.36 | 15.35 | 15.17 | 15.29 | - | - |
| 54 | Sulphate of Potash, | 6.00 | - | - | - | - | - | - | - | - | - | 26.52 | 25.93—28.10 |
| 134 | Muriate of Potash, | 1.75 | - | - | - | - | - | - | - | - | - | 48.90 | - |
| 183 | Sulphate of Potash, | 6.10 | - | - | - | - | - | - | - | - | - | 29.30 | 27.02—29.72 |
| 232 | Sulphate of Potash, | .14 | - | - | - | - | - | - | - | - | - | 51.00 | 48.65—51.35 |

* Sulphate of potash, the source of potash.

## 4. Analyses of Licensed Fertilizers, etc. — *Continued.*

| Laboratory Number. | Name of Brand. | Name of Manufacturer. | Sampled at— |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 4 | Four-fold Fertilizer, | Walker, Stratman & Co., Pittsburg, Pa., | Amherst. |
| 15 | Potato Manure, | Bradley Fertilizer Company, Boston, Mass., | Springfield. |
| 20 | Potato Manure, | Bradley Fertilizer Company, Boston, Mass., | Worcester. |
| 23 | Complete Manure for Top-dressing Grass, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 31 | Superphosphate, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 33 | A. A. Ammoniated Superphosphate, | H. J. Baker & Bro., New York, N. Y., | Springfield. |
| 37 | Lawn and Garden Dressing, | Bowker Fertilizer Company, Boston, Mass., | Springfield. |
| 60 | Fish and Potash, | Bradley Fertilizer Company, Boston, Mass., | North Amherst. |
| 66 | Hill and Drill Phosphate, | Bowker Fertilizer Company, Boston, Mass., | Boston. |
| 78 | Royal Bone Phosphate, | Williams & Clark Fertilizer Company, Boston, Mass., | Lowell. |
| 79 | Prolific Crop Producer, | Williams & Clark Fertilizer Company, Boston, Mass., | Lowell. |
| 84 | Lawn and Garden Dressing, | Bowker Fertilizer Company, Boston, Mass., | Lawrence. |
| 95 | Farmers' New Method Fertilizer, | Bradley Fertilizer Company, Boston, Mass., | Amesbury. |
| 116 | Hill and Drill Phosphate, | Bowker Fertilizer Company, Boston, Mass., | So. Framingham. |
| 208 | Four-fold Fertilizer, | Walker, Stratman & Co., Pittsburg, Pa., | Leeds. |
| | *Chemicals.* | | |
| 6 | Nitrate of Soda, | Williams & Clark Fertilizer Company, Boston, Mass., | Hadley. |
| 7 | Dissolved Bone-black, | Williams & Clark Fertilizer Company, Boston, Mass., | Hadley. |

| | | | |
|---|---|---|---|
| 25 | Nitrate of Soda, | Bradley Fertilizer Company, Boston, Mass., | Worcester. |
| 30 | Nitrate of Soda, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 38 | Muriate of Potash, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 39 | Dissolved Bone-black, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 44 | Sulphate of Potash, | Bradley Fertilizer Company, Boston, Mass., | Worcester. |
| 58 | Nitrate of Soda, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| 59 | Muriate of Potash, | Bowker Fertilizer Company, Boston, Mass., | Amherst. |
| 137 | Nitrate of Soda, | Clark's Cove Fertilizer Company, Boston, Mass., | Dighton. |
| 180 | Nitrate of Soda, | Quinnipiac Fertilizer Company, Boston, Mass., | Williamstown. |
| 181 | Dissolved Bone-black, | Lucien Sanderson, New Haven, Conn., | Greenfield. |
| 182 | Nitrate of Soda, | Lucien Sanderson, New Haven, Conn., | Greenfield. |
| 194 | Sulphate of Potash, | Quinnipiac Fertilizer Company, Boston, Mass., | Williamstown. |
| 196 | Muriate of Potash, | Lucien Sanderson, New Haven, Conn., | Greenfield. |
| 211 | Sulphate of Potash, | National Fertilizer Company, Bridgeport, Conn., | Hadley. |
| 233 | Sulphate of Potash, | Clark's Cove Fertilizer Company, Boston, Mass., | Agawam. |
| | *Bones.* | | |
| 63 | Fresh Ground Bone, | Bowker Fertilizer Company, Boston, Mass., | Boston. |
| 104 | Pure Ground Bone, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Fitchburg. |
| 107 | Pure Ground Bone, | John C. Dow & Co., Boston, Mass., | Lowell. |
| 114 | Fresh Ground Bone, | Bowker Fertilizer Company, Boston, Mass., | So. Framingham. |
| 161 | Pure Ground Bone, | John C. Dow & Co., Boston, Mass., | Amherst. |

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | Moisture. | NITROGEN IN ONE HUNDRED POUNDS. | | PHOSPHORIC ACID IN ONE HUNDRED POUNDS. | | | | | | | POTASSIUM OXIDE IN ONE HUNDRED POUNDS. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | TOTAL. | | AVAILABLE. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| | *Compound Fertilizers.* | | | | | | | | | | | | |
| 4<br>208 | Four-fold Fertilizer, | 10.88 | 1.65 | 1.65—2.47 | 4.55 | 2.98 | 4.27 | 11.80 | 10—11 | 7.53 | 8—9 | 4.32 | 2—3 |
| 15<br>20 | Potato Manure, | 13.10 | 2.55 | 2.50—3.25 | 4.06 | 2.67 | 1.94 | 8.67 | 8—11 | 6.73 | 6—8 | 4.93 | 5—6 |
| 23 | Complete Manure for Top-dressing Grass, | 6.60 | 4.48 | 4.62—4.94 | .76 | 3.35 | 1.77 | 5.88 | 7—8 | 4.11 | 4—5 | 8.04 | 8—10 |
| 31 | Superphosphate, | 16.06 | 2.32 | 2.47—3.30 | 4.96 | 3.81 | 3.20 | 11.97 | 10—12 | 8.77 | 8—10 | 3.01 | 3—4 |
| 33 | A. A. Ammoniated Superphosphate, | 13.77 | 2.72 | 2.47—3.30 | 7.69 | 2.13 | .84 | 10.66 | 10.25—14.5 | 9.82 | 10—12 | 2.79 | 2—3 |
| 37<br>84 | Lawn and Garden Dressing, | 9.33 | 4.10 | 4—5 | 5.84 | 1.82 | 4.46 | 12.12 | 6—8 | 7.66 | 5—6 | 7.68 | 5—6 |
| 60 | Fish and Potash, | 22.04 | 2.38 | 2.48—3.50 | 2.50 | 3.28 | 1.51 | 7.29 | 7.5—8.5 | 5.78 | 6—8 | 2.67 | 2—3 |
| 66<br>116 | Hill and Drill Phosphate, | 12 | 2.95 | 2.5—3.25 | 6.52 | 3.96 | 2.56 | 13.04 | 11—15 | 10.48 | 10—13 | 2.65 | 2—3 |
| 78 | Royal Bone Phosphate, | 19.26 | .95 | 1.03—1.65 | 5.25 | 3.12 | 2.15 | 10.52 | 8—11 | 8.37 | 7—9 | 2.48 | 2—3* |
| 79 | Prolific Crop Producer, | 18.73 | 1.02 | .82—1.64 | 5.01 | 3.21 | 2.17 | 10.39 | 7—11 | 8.22 | 6—9 | 2.73 | 1—2 |
| 95 | Farmers' New Method Fertilizer, | 16.85 | 1.18 | 1—2 | 5.42 | 2.61 | 1.69 | 9.72 | 10—13 | 8.03 | 8—10 | 2.29 | 2.16—2.70* |
| | *Chemicals.* | | | | | | | | | | | | |
| 6 | Nitrate of Soda, | 1.30 | 16.17 | - | - | - | - | - | - | - | - | - | - |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Dissolved Bone-black, | 15.66 | - | - | 10.54 | 1.76 | .44 | 12.74 | - | 12.30 | - | - | | - | |
| 25 | Nitrate of Soda, | 1.12 | 16.04 | 14.83—16.48 | - | - | - | - | - | - | - | - | | - | |
| 30 | Nitrate of Soda, | .92 | 16.12 | 15.81—16.14 | - | - | - | - | - | - | - | - | | - | |
| 38 | Muriate of Potash, | .02 | - | - | - | - | - | - | - | - | - | 54.10 | | 53.70—56.86 | |
| 39 | Dissolved Bone-black, | 16.25 | - | - | 15.42 | .68 | .18 | 16.28 | 17—18 | 16.10 | - | - | | - | |
| 44 | Sulphate of Potash, | .55 | - | - | - | - | - | - | - | - | - | 49.70 | | 48—52 | |
| 58 | Nitrate of Soda, | 1.75 | 16.05 | 15.65—16.14 | - | - | - | - | - | - | - | - | | - | |
| 59 | Muriate of Potash, | .12 | - | - | - | - | - | - | - | - | - | 52.20 | | 50.54—53.70 | |
| 137 | Nitrate of Soda, | .85 | 16.03 | 15.66 | - | - | - | - | - | - | - | - | | - | |
| 180 | Nitrate of Soda, | 1.55 | 15.85 | 14.87—16.06 | - | - | - | - | - | - | - | - | | - | |
| 181 | Dissolved Bone-black, | 14.00 | - | - | 15.86 | .43 | 2.43 | 18.72 | 16—18 | 16.29 | - | - | | - | |
| 182 | Nitrate of Soda, | 2.37 | 16.11 | 14.90—16.48 | - | - | - | - | - | - | - | - | | - | |
| 194 | Sulphate of Potash, | 1.35 | - | - | - | - | - | - | - | - | - | 49.40 | | - | |
| 196 | Muriate of Potash, | 1.19 | - | - | - | - | - | - | - | - | - | 52.05 | | 50.54—53.70 | |
| 211 | Sulphate of Potash, | 1.45 | - | - | - | - | - | - | - | - | - | 46.30 | | - | |
| 233 | Sulphate of Potash, | 3.01 | - | - | - | - | - | - | - | - | - | 25.50 | | 25.93—28.10 | |
| | *Bones.* | | | | | | | | | | | MECHANICAL ANALYSIS. | | | |
| | | | | | | | | | | | | Fine. | Med. Fine. | Med. | Coarse Med. |
| 63<br>114 | Fresh Ground Bone, | 5.98 | 3.23 | 2.47—3.30 | 2.89 | 13.07 | 2.97 | 18.83 | 18—22 | 15.96 | 5—7 | 33.10 | 31.39 | 26.27 | 9.24 |
| 104 | Pure Ground Bone, | 8.57 | 3.87 | 3.5—4.5 | - | 3.42 | 22.08 | 25.50 | 24—26 | 3.42 | - | .53 | 29.46 | 55.37 | 14.64 |
| 107<br>161 | Pure Ground Bone, | 3.43 | 1.79 | 1.65—2.47 | .20 | 16.82 | 10.69 | 27.71 | 24—26 | 17.02 | - | 58.24 | 38.06 | 3.70 | - |

* Sulphate of potash, the source of potash.

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

| Laboratory Number. | NAME OF BRAND. | NAME OF MANUFACTURER. | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 99 | Wheat and Corn Phosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Fitchburg. |
| 115 | Potato Phosphate, | Cleveland Dryer Company, Boston, Mass., | So. Framingham. |
| 121 | Corn Fertilizer, | J. J. H. Gregory & Son, Marblehead, Mass., | Amherst. |
| 132 | Dry Ground Menhaden Fish Guano, | W. J. Brightman & Co., Tiverton, R. I., | Fall River. |
| 143 | High-grade Special, | Williams & Clark Fertilizer Company, Boston, Mass., | Dighton. |
| 144 | Fish and Potash, | Clark's Cove Fertilizer Company, Boston, Mass., | Dighton. |
| 151 | Wheat and Corn Phosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 156 | Ammoniated Practical Superphosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 158 | New Rival Ammoniated Superphosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Amherst. |
| 164 | Canada Hardwood Unleached Ashes, | Allison, Stroup & Co., Boston, Mass., | Williamstown. |
| 175 | New England Favorite, | J. S. Reese & Co., Baltimore, Md., | Pittsfield. |
| 176 | Fish and Potash, | Williams & Clark Fertilizer Company, Boston, Mass., | Greenfield. |
| 178 | Grass Fertilizer, | Quinnipiac Fertilizer Company, Boston, Mass., | Pittsfield. |
| 179 | Complete Fertilizer for Potatoes, | National Fertilizer Company, Bridgeport, Conn., | Pittsfield. |
| 186 | Wheat and Corn Phosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | North Adams. |
| 187 | Bay State Fertilizer (G. G. Brand), | Clark's Cove Fertilizer Company, Boston, Mass., | Greenfield. |

| | | | |
|---|---|---|---|
| 189 | Grass Fertilizer, | Quinnipiac Fertilizer Company, Boston, Mass., | Williamstown. |
| 191 | Standard Fertilizer, | Standard Fertilizer Company, Boston, Mass., | Great Barrington. |
| 192 | Lawn Dressing, | Williams & Clark Fertilizer Company, Boston, Mass., | North Adams. |
| 197 | Blood, Meat and Bone, | Lucien Sanderson, New Haven, Conn., | Greenfield. |
| 200 | Superphosphate No. 2, | Preston Fertilizer Company, Greenpoint, L. I., | Williamstown. |
| 202 | Fine Dry Ground Fish, | Bowker Fertilizer Company, Boston, Mass., | Northampton. |
| 204 | Complete Grass Manure, | H. J. Baker & Bro., New York, N. Y., | Northampton. |
| 206 | Dry Ground Fish, | National Fertilizer Company, Bridgeport, Conn., | Hadley. |
| 210 | Excelsior Tobacco Grower, | E. Frank Coe, New York, N. Y., | Hadley. |
| 212 | High-grade Fish Guano and Potash, | E. Frank Coe, New York, N. Y., | Hadley. |
| 213 | Dry Ground Fish, | National Fertilizer Company, Bridgeport, Conn., | Hadley. |
| 220 | Fish and Potash, | Leander Wilcox, Mystic, Conn., | Amherst. |
| 221 | Corn Phosphate, | Williams & Clark Fertilizer Company, Boston, Mass., | Amherst. |
| 235 | Potato Special, | J. S. Reese & Co., Baltimore, Md., | Chicopee. |
| 236 | Whittemore's Complete Manure, | Whittemore Bros., Wayland, Mass., | Amherst. |

## 4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Concluded.*

| Laboratory Number. | NAME OF BRAND. | Moisture. | NITROGEN IN ONE HUNDRED POUNDS. |  | PHOSPHORIC ACID IN ONE HUNDRED POUNDS. |  |  |  |  |  |  | POTASSIUM OXIDE IN ONE HUNDRED POUNDS. |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  | TOTAL. |  | AVAILABLE. |  |  |  |
|  |  |  | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
|  | *Compound Fertilizers.* |  |  |  |  |  |  |  |  |  |  |  |  |
| 99<br>151<br>186 | Wheat and Corn Phosphate, | 14.61 | 1.78 | 2—3 | 7.32 | 2.50 | 2.05 | 11.87 | 11—15 | 9.82 | 10—13 | 1.82 | 1.6—2.7* |
| 115 | Potato Phosphate, | 16.68 | 2.23 | 2—2.25 | 7.22 | 1.91 | 1.69 | 10.82 | 9—13 | 9.13 | 8—10 | 3.81 | 3—4* |
| 121 | Corn Fertilizer, | 6.85 | 3.12 | 3.09 | 1.25 | 4.71 | 2.41 | 8.37 | 7 | 5.96 | 5.5 | 12.96 | 15 |
| 132 | Dry Ground Menhaden Fish Guano, | 9.77 | 8.86 | 8.24—9.89 | .56 | 3.23 | 3.17 | 6.96 | 6.87—9.16 | 3.79 | - | - | - |
| 143 | High-grade Special, | 11.26 | 3.68 | 3.30—4.12 | 7.60 | 1.22 | .90 | 9.72 | 8—11 | 8.82 | 7—9 | 7.90 | 7—9 |
| 144 | Fish and Potash, | 21.96 | 2.65 | 2.47—4.12 | 2.97 | 2.58 | 1.82 | 7.37 | 7—9 | 5.55 | 6—8 | 2.61 | 3—5* |
| 156 | Ammoniated Practical Superphosphate, | 12.31 | 1.14 | .82—1.64 | 5.95 | .62 | 2.38 | 8.94 | 8—10 | 6.57 | 8—10 | 1.31 | 1—2 |
| 158 | New Rival Ammoniated Superphosphate, | 16.18 | 1.43 | 1.20—2 | 7.42 | 2.18 | 1.66 | 11.26 | 10—12 | 9.60 | 10—12 | 1.58 | 1.60—3 |
| 164 | Canada Hardwood Unleached Ashes, | 8.88 | - | - | - | - | - | 1.79 | 1.36—1.83 | - | - | 8.26 | 5.84—6.80 |
| 175 | New England Favorite, | 18.97 | 2.45 | 2.47—3.30 | 4.78 | 4.24 | 1.54 | 10.56 | 11—14 | 9.02 | 9—12 | 2.04 | 2—3 |
| 176 | Fish and Potash, | 22.34 | 2.10 | 2.06—2.88 | 2.64 | 3.27 | 1.02 | 6.93 | 6—9 | 5.91 | 4—6 | 4.61 | 4—6* |
| 178<br>189 | Grass Fertilizer, | 9.81 | 4.26 | 3.91—4.74 | 2.25 | 3.73 | 2.00 | 7.98 | 6—8 | 5.98 | 5—7 | 3.25 | 2—3* |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 179 | Complete Fertilizer for Potatoes, | 12.93 | 4.60 | 3.30—4.12 | 7.12 | 2.64 | .30 | 10.06 | 10—12 | 9.76 | 8—10 | 5.44 | 6—8 |
| 187 | Bay State Fertilizer (G. G. Brand), | 13.58 | 2.09 | 1.85—2.68 | 6.45 | 2.05 | 1.92 | 10.44 | 10—13 | 8.50 | 8.5—11 | 2.13 | 2—3* |
| 191 | Standard Fertilizer, | 15.46 | 2.00 | 2—3 | 6.60 | 2.99 | 1.54 | 11.13 | 10—15 | 9.59 | 8—12 | 2.27 | 2—3 |
| 192 | Lawn Dressing, | 8.78 | 4.31 | 4.95—5.78 | 1.90 | 3.60 | 1.28 | 6.78 | 6—8 | 5.50 | 5—7 | 3.36 | 2.5—3.5 |
| 197 | Blood, Meat and Bone, | 6.30 | 5.54 | 5.77—7.41 | .38 | 3.58 | 5.12 | 9.08 | 10.12 | 3.96 | - | - | - |
| 200 | Superphosphate No. 2, | 15.33 | 1.71 | .82—1.65 | 7.70 | 1.80 | 1.02 | 10.52 | - | 9.50 | 10—12 | 2.23 | 1—2 |
| 202 | Fine Dry Ground Fish, | 15.96 | 8.32 | 8—10 | .51 | 4.09 | 1.51 | 6.14 | 7—8 | 4.60 | - | - | - |
| 204 | Complete Grass Manure, | 11.00 | 3.60 | 3.71 | 2.41 | 3.99 | 1.33 | 7.73 | - | 6.40 | 3 | 7.69 | 7 |
| 206<br>213 | Dry Ground Fish, | 16.77 | 8.17 | 8.24—9.89 | .40 | 5.34 | 1.76 | 7.50 | 6—8 | 5.74 | - | - | - |
| 210 | Excelsior Tobacco Grower, | 7.84 | 3.10 | 3—4 | 8.75 | 1.53 | 1.64 | 11.92 | 8—11 | 10.28 | 8—11 | 4.93 | 5—6* |
| 212 | High-grade Fish Guano and Potash, | 10.78 | 2.73 | 3.30—4.10 | 2.46 | 4.20 | 3.08 | 9.74 | 7—11 | 6.66 | 6—9 | 2.92 | 2.75* |
| 220 | Fish and Potash, | 13.15 | 3.44 | 3.25—4.25 | 2.38 | 2.71 | 1.46 | 6.55 | 6—7 | 5.09 | 5—6 | 4.45 | 4—5 |
| 221 | Corn Phosphate, | 14.52 | 2.52 | 2.06—2.88 | 7.16 | 4.38 | 2.22 | 13.76 | 10.25—14 | 11.54 | 9—12 | 1.62 | 1.5—2.5 |
| 235 | Potato Special, | 14.11 | 2.72 | 2.88—3.71 | 7.78 | 1.95 | .20 | 9.93 | - | 9.73 | 6—8 | 7.65 | 7.5—9.5 |
| 236 | Whittemore's Complete Manure, | 11.69 | 3.30 | 2.47—3.30 | 6.24 | 5.86 | 1.84 | 13.94 | 12—14 | 12.10 | 8.12 | 4.30 | 3—4 |

* Sulphate of potash, the source of potash.

## 5. ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

### *Wood Ashes.*

[I., sent on from Marblehead, Mass.; II., sent on from Westminster, Mass.; III., sent on from South Sudbury, Mass.; IV., sent on from South Deerfield, Mass.; V., sent on from Concord, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 18.06 | 6.51 | 4.80 | 4.67 | 15.40 |
| Potassium oxide, | 4.17 | 5.27 | 3.42 | 2.12 | 7.73 |
| Calcium oxide, | 24.68 | 38.92 | 43.40 | 49.36 | 34.27 |
| Phosphoric acid, | .79 | 1.23 | 1.71 | .61 | 1.13 |
| Insoluble matter (before calcination), | 27.66 | 21.09 | 10.51 | 5.63 | 12.45 |
| Insoluble matter (after calcination), | 25.06 | 19.32 | 9.02 | 4.04 | 11.11 |

### *Wood Ashes.*

[I. and II., sent on from Concord, Mass.; III., sent on from Rock Bottom, Mass.; IV. and V., sent on from Sunderland, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 11.39 | 7.87 | 19.85 | 11.15 | 16.17 |
| Potassium oxide, | 8.39 | 5.56 | 3.66 | 5.83 | 5.94 |
| Calcium oxide, | 33.05 | 37.93 | –* | –* | –* |
| Phosphoric acid, | 1.74 | .74 | .95 | 1.83 | Trace |
| Insoluble matter (before calcination), | 16.11 | 19.02 | 16.89 | 23.85 | 31.13 |
| Insoluble matter (after calcination), | 14.27 | 17.64 | 13.24 | 18.17 | 20.02 |

* Not determined.

### *Wood Ashes.*

[I. and II., sent on from Lowell, Mass.; III. and IV., sent on from Boston, Mass.; V., sent on from Amherst, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 7.30 | 3.39 | 16.59 | 9.51 | 24.63 |
| Potassium oxide, | 4.97 | 5.52 | 6.45 | 5.72 | 7.63 |
| Phosphoric acid, | .46 | 2.41 | .77 | .56 | .82 |
| Insoluble matter (after calcination), | 17.98 | 15.72 | 6.02 | 13.25 | .46 |

## 5. Analyses, etc. — *Continued.*

### *Wood Ashes.*

[I , sent on from Tewksbury, Mass.; II. and III., sent on from Concord, Mass.; IV. and V., sent on from North Amherst, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., . . | 11.30 | 15.01 | 8.49 | 18.13 | 14.25 |
| Potassium oxide, . . . | 6.80 | 8.05 | 7.10 | 5.05 | 5.95 |
| Phosphoric acid, . . . | 1.69 | .67 | .31 | .92 | 1.43 |
| Insoluble matter (before calcination), . . . . . | 16.56 | 18.38 | 16.97 | 15.33 | 15.03 |
| Insoluble matter (after calcination), . . . . | 13.66 | 15.84 | 15.25 | 13.46 | 12.75 |

### *Wood Ashes.*

[I., sent on from Winchendon, Mass.; II., sent on from North Hadley, Mass.; III., sent on from Concord, Mass.; IV., sent on from Framingham, Mass.; V., sent on from North Sudbury, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I | II. | III. | IV. | V. |
| Moisture at 100° C., . . | 23.07 | 4.48 | 16.16 | 16.39 | 17.74 |
| Potassium oxide, . . . | 2.87 | 6.75 | 5.88 | 4.83 | 6.45 |
| Calcium oxide, . . . | 33.04 | 37.32 | 32.46 | 35.52 | 33.76 |
| Phosphoric acid, . . . | 1.48 | 1.82 | 1.07 | 1.33 | 1.00 |
| Insoluble matter (before calcination), . . . . . | 10.96 | 15.53 | 15.34 | 10.07 | 13.37 |
| Insoluble matter (after calcination), . . . . | 9.29 | 13.72 | 13.09 | 9.28 | 12.13 |

### *Wood Ashes.*

[I. and II., sent on from Concord, Mass.; III., sent on from Eastham, Mass ; IV., sent on from Westborough, Mass.; V., sent on from Sunderland, Mass ]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., . . | 8.96 | 13.00 | 15.33 | 20.57 | 19.52 |
| Potassium oxide, . . . | 3.00 | 8.74 | 5.96 | 5.93 | 6.21 |
| Calcium oxide, . . . | 25.60 | 36.44 | 36.14 | 32.03 | 29.51 |
| Phosphoric acid, . . . | .97 | 1.79 | .26 | 1.48 | 1.83 |
| Insoluble matter (before calcination), . . . . . | 36.93 | 8.44 | 12.91 | 10.05 | 13.47 |
| Insoluble matter (after calcination), . . . . | 34.89 | 6.40 | 10.38 | 8.09 | 10.85 |

## 5. ANALYSES, ETC. — *Continued.*

### *Wood Ashes.*

[I. and II., sent on from Waltham, Mass.; III., sent on from Westminster, Mass.; IV. and V., sent on from Montague, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 8.97 | 23.75 | 3.13 | 16.53 | 26.80 |
| Potassium oxide, | 6.86 | 4.68 | 4.73 | 4.24 | 4.00 |
| Phosphoric acid, | 1.56 | .90 | 1.33 | 1.15 | 1.20 |
| Insoluble matter (after calcination), | 17.07 | 17.43 | 22.03 | 15.73 | 13.55 |

### *Wood Ashes.*

[I. and II., sent on from Concord, Mass.; III., sent on from North Amherst, Mass.; IV., sent on from Hadley, Mass; V., sent on from Sudbury, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 20.98 | 9.39 | 17.35 | 13.43 | 11.48 |
| Potassium oxide, | 3.23 | 7.64 | 7.07 | 5.76 | 4.10 |
| Calcium oxide, | 46.44 | 39.00 | 35.51 | –* | –* |
| Phosphoric acid, | 1.02 | 1.69 | 1.64 | 1.54 | 1.66 |
| Insoluble matter (before calcination), | 15.73 | 15.44 | 8.60 | –* | –* |
| Insoluble matter (after calcination), | 14.10 | 13.95 | 6.30 | 10.23 | 15.33 |

### *Wood Ashes.*

[I. and II., sent on from North Amherst, Mass.; III, sent on from Westborough, Mass.; IV., sent on from Acton, Mass.; V., sent on from South Framingham, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 8.21 | 11.28 | 5.50 | 23.49 | 6.58 |
| Potassium oxide, | 5.99 | 6.81 | 6.93 | 3.56 | 4.79 |
| Calcium oxide, | 39.48 | 40.24 | 45.20 | –* | –* |
| Phosphoric acid, | 1.13 | 1.28 | 1.41 | 1.25 | 1.02 |
| Insoluble matter (before calcination), | 10.33 | 10.58 | 10.57 | 11.02 | –* |
| Insoluble matter (after calcination), | 9.15 | 9.33 | 8.57 | 9.11 | 12.49 |

* Not determined.

### 5. ANALYSES, ETC. — *Continued.*

### *Wood Ashes.*

[I. and II., sent on from South Sudbury, Mass.; III. and IV., sent on from Concord, Mass.; V., sent on from Acton, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 10.61 | 20.80 | 10.85 | 17.09 | 21.30 |
| Potassium oxide, | 5.24 | 4.19 | 4.33 | 5.00 | 4.00 |
| Phosphoric acid, | 1.20 | .67 | 3.75 | 1.05 | 1.13 |
| Insoluble matter (before calcination), | 29.60 | 25.39 | 12.00 | 18.42 | 8.97 |

### *Wood Ashes.*

[I. and II., sent on from Southampton, Mass.; III. and IV., sent on from Concord, Mass.; V., sent on from Sunderland, Mass ]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 6.72 | 16.75 | 13.00 | 22.21 | 37.56 |
| Potassium oxide, | 5.72 | 4.58 | 9.46 | 4.40 | 1.51 |
| Calcium oxide, | –* | –* | 35.88 | 34.24 | –* |
| Phosphoric acid, | .38 | 1.51 | 1.13 | .56 | .67 |
| Insoluble matter (before calcination), | –* | –* | 8.72 | 16.15 | –* |
| Insoluble matter (after calcination), | 7.22 | 26.37 | 6.90 | 13.65 | 10.38 |

### *Wood Ashes.*

[I. and II., sent on from Concord, Mass.; III., sent on from East Whately, Mass.; IV., sent on from West Northfield, Mass.; V., sent on from Sunderland, Mass ]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 19.43 | 14.04 | 11.06 | 5.04 | 21.83 |
| Potassium oxide, | 4.55 | 6.57 | 4.81 | 6.35 | 6.12 |
| Calcium oxide, | 35.48 | 34.55 | –* | –* | –* |
| Phosphoric acid, | .81 | 1.60 | .82 | 1.54 | 1.74 |
| Insoluble matter (before calcination), | 17.58 | 13.50 | –* | –* | –* |
| Insoluble matter (after calcination), | 14.79 | 11.28 | 5.76 | 13.55 | 11.78 |

* Not determined.

## 5. ANALYSES, ETC. — *Continued.*

### *Wood Ashes.*

[I. and II., sent on from Concord, Mass.; III., sent on from Hadley, Mass.; IV., sent on from Sunderland, Mass.; V., sent on from West Northfield, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 14.16 | 16.19 | 10.44 | 15.79 | 10.44 |
| Potassium oxide, | 5.78 | 6.36 | 6.38 | 6.86 | 5.46 |
| Calcium oxide, | 32.47 | 34.16 | –* | –* | –* |
| Phosphoric acid, | 1.61 | 1.00 | 1.28 | .95 | .05 |
| Insoluble matter (before calcination), | 15.46 | 14.35 | –* | –* | –* |
| Insoluble matter (after calcination), | 13.06 | 12.27 | 23.08 | 18.17 | 25.08 |

* Not determined.

### *Wood Ashes.*

[I. and II., sent on from West Northfield, Mass; III., sent on from Amherst, Mass.; IV., sent on from Boston, Mass.; V., sent on from Pelham, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 10.92 | 5.36 | 9.52 | 8.11 | 11.22 |
| Potassium oxide, | 5.07 | 7.00 | 4.31 | 4.88 | 4.95 |
| Phosphoric acid, | 1.07 | 1.97 | 1.23 | 1.31 | 1.64 |
| Insoluble matter (after calcination), | 21.19 | 18.65 | 14.35 | 16.18 | 15.21 |

### *Wood Ashes.*

[I. and II, sent on from Concord, Mass.; III., sent on from Danvers, Mass.; IV., sent on from Amherst, Mass.; V., sent on from Westborough, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 16.38 | 9.90 | 10.49 | 16.18 | 15.33 |
| Potassium oxide, | 6.55 | 7.44 | 5.57 | 3.39 | 6.25 |
| Phosphoric acid, | .51 | 1.71 | 1.07 | 1.28 | 1.20 |
| Insoluble matter (after calcination), | 10.16 | 16.79 | 11.25 | 15.36 | 9.07 |

### 5. Analyses, etc. — *Continued.*

### *Wood Ashes.*

[I. and II., sent on from Concord, Mass.; III., sent on from Hudson, Mass.; IV., sent on from Hingham, Mass.; V., sent on from Granby, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 4.87 | 11.22 | 17.70 | 2.37 | 11.07 |
| Potassium oxide, | 4.82 | 4.10 | 4.13 | 4.79 | 4.40 |
| Calcium oxide, | 37.00 | 32.60 | 33.20 | 32.80 | 42.80 |
| Phosphoric acid, | 1.40 | 1.28 | 1.28 | 1.16 | 1.80 |
| Insoluble matter (after calcination), | 22.81 | 18.06 | 14.31 | 30.38 | 13.91 |

### *Wood Ashes.*

[I. and II., sent on from North Amherst, Mass.; III., sent on from South Deerfield, Mass.; IV., sent on from Concord, Mass.; V., sent on from South Sudbury, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | .30 | 1.65 | 3.60 | 7.35 | 29.48 |
| Potassium oxide, | 5.30 | 9.22 | 5.56 | 4.74 | 2.38 |
| Calcium oxide, | –* | –* | 41.97 | 42.40 | 37.71 |
| Phosphoric acid, | 3.08 | 1.54 | .77 | 1.66 | 1.08 |
| Insoluble matter (after calcination), | 5.12 | 10.90 | 21.23 | 16.78 | 3.75 |

### *Wood Ashes.*

[I., sent on from Amherst, Mass.; II. and III., sent on from Hadley, Mass.; IV., sent on from North Amherst, Mass.; V., sent on from West Northfield, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 13.57 | 16.85 | 30.38 | 18.05 | 9.19 |
| Potassium oxide, | 7.63 | 5.88 | 4.48 | 4.04 | 5.70 |
| Calcium oxide, | 32.51 | 36.42 | 26.55 | –* | 36.00 |
| Phosphoric acid, | 1.45 | 1.51 | 1.22 | 1.15 | 1.41 |
| Insoluble matter (after calcination), | 32.57 | 4.46 | 11.01 | 11.41 | 12.58 |

* Not determined.

## 5. Analyses, etc. — *Continued.*

### *Wood Ashes.*

[I., sent on from Marlborough, Mass.; II., sent on from Amherst, Mass.; III., IV. and V., sent on from Marblehead, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 2.98 | 4.21 | 20.97 | 12.72 | 11.30 |
| Potassium oxide, | 4.98 | 3.82 | 5.12 | 5.48 | 4.60 |
| Calcium oxide, | 37.26 | 31.14 | 31.80 | 37.00 | 40.40 |
| Phosphoric acid, | 1.15 | 2.98 | .70 | 1.22 | 1.79 |
| Insoluble matter, | 25.25 | 18.97 | 14.73 | 15.12 | 10.60 |

### *Wood Ashes.*

[I., sent on from Hudson, Mass.; II., sent on from Hingham, Mass.; III. and IV., sent on from Granby, Mass.; V., sent on from Amesbury, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 17.70 | 2.37 | 11.07 | 1.17 | 10.41 |
| Potassium oxide, | 4.13 | 4.79 | 4.40 | 4.31 | 4.33 |
| Calcium oxide, | 33.20 | 32.80 | 42.80 | 25.60 | 32.67 |
| Phosphoric acid, | 1.28 | 1.16 | 1.80 | 1.54 | .90 |
| Insoluble matter, | 14.31 | 30.38 | 13.91 | 39.49 | 16.65 |

### *Wood Ashes.*

[I., sent on from Merrimac, Mass.; II. and III., sent on from Boston, Mass.; IV., sent on from Clinton, Mass.; V., sent on from Fall River, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 10.67 | 5.18 | 9.81 | 25.28 | 9.78 |
| Potassium oxide, | 5.74 | 5.93 | 4.90 | 3.72 | 4.71 |
| Calcium oxide, | 38.60 | 39.40 | 44.40 | –* | –* |
| Phosphoric acid, | 1.28 | .96 | 1.66 | 1.25 | 1.51 |
| Insoluble matter, | 11.75 | 6.97 | 1.40 | 12.38 | 18.52 |

* Not determined.

5. ANALYSES, ETC. — *Continued.*

### *Cotton-hull Ashes.*

[I. and II , sent on from Boston, Mass.; III., sent on from Amherst, Mass.; IV., sent on from Agawam, Mass.]

| | PER CENT. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 9.87 | 7.77 | 14.78 | 13.92 |
| Potassium oxide, | 24.06 | 20.40 | 23.96 | 24.12 |
| Phosphoric acid, | 7.68 | 7.83 | 7.93 | 9.21 |
| Insoluble matter, | 15.38 | 11.78 | 10.10 | 9.33 |

### *Ashes from Cremation of Swill.*

[Sent on from Lowell, Mass.]

| | PER CENT. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | .51 | .07 | .04 | .11 |
| Potassium oxide, | 1.73 | 8.83 | 7.03 | 1.25 |
| Calcium oxide, | 24.79 | 28.18 | 33.74 | 47.60 |
| Magnesium oxide, | 1.87 | –* | –* | –* |
| Ferric and aluminic oxides, | 3.57 | 7.63 | 6.25 | 1.06 |
| Phosphoric acid, | 16.61 | 17.18 | 26.09 | 32.26 |
| Insoluble matter (before calcination), | 39.60 | 18.49 | 14.40 | 15.13 |
| Insoluble matter (after calcination), | 29.72 | 16.53 | 11.41 | 13.20 |

* Not determined.

### *Logwood Ashes.*

[Sent on from Boston, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | .55 |
| Potassium oxide, | .26 |
| Calcium oxide, | 58.26 |
| Magnesium oxide, | 1.46 |
| Ferric and aluminic oxides, | 1.46 |
| Phosphoric acid, | .70 |
| Carbonic acid, | 32.95 |
| Insoluble matter, | 3.09 |

### *Sewage.*

[Sent on from Danvers, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 99.959 |
| Potassium oxide, | .0033 |
| Phosphoric acid, | .0012 |
| Nitrogen, | .0028 |

## 5. ANALYSES, ETC. — *Continued.*

### *Peat.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 27.51 |
| Nitrogen, | .12 |

### *Florida Muck.*

[Sent on from Boston, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.94 |
| Nitrogen, | 1.07 |

### *Canal Mud.*

[Sent on from North Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 60.93 |
| Potassium oxide, | – |
| Phosphoric acid, | .28 |
| Nitrogen, | .15 |
| Insoluble matter, | 32.67 |

### *Muck.*

[I , sent on from Rockbottom, Mass.; II., sent on from Pansy Park, Mass ]

| | PER CENT. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 78.06 | 81.09 |
| Nitrogen, | .43 | .42 |

### *Horse Manure.*

[Sent on from Westborough, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C , | 11.25 |
| Potassium oxide, | 2.82 |
| Phosphoric acid, | 1.46 |
| Nitrogen, | .74 |
| Insoluble matter, | 12.60 |

### *Boiler Soot.*

[Sent on from Hatfield, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 18.80 |
| Potassium oxide, | .54 |
| Phosphoric acid, | 1.60 |
| Calcium oxide, | 2.31 |
| Magnesium oxide, | 1.19 |
| Insoluble matter, | 58.91 |

## 5. ANALYSES, ETC. — *Continued.*

### *Castor Pomace.*

[I., sent on from Amherst, Mass.; II., sent on from Hatfield, Mass.]

| | PER CENT. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 10.08 | 8.07 |
| Potassium oxide, | 3.40 | –* |
| Phosphoric acid, | 2.26 | –* |
| Nitrogen, | 5.60 | 5.22 |
| Insoluble matter, | 1.70 | –* |

* Not determined.

### *Muriate of Potash.*

[I., sent on from North Amherst, Mass.; II., sent on from Amherst, Mass.]

| | PER CENT. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C, | 1.98 | .30 |
| Potassium oxide, | 52.00 | 36 00 |
| Insoluble matter, | .26 | .18 |

### *Saltpetre.*

[Sent on from South Acton, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | .66 |
| Potassium oxide, | 45.74 |
| Nitrogen, | 11.88 |

### *Saltpetre Waste.*

[Sent on from Townsend Harbor, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 1.90 |
| Potassium oxide, | 6.24 |
| Sodium oxide, | 43.01 |
| Chlorine, | 43.69 |
| Nitrogen, | 1.56 |

### *Sulphate of Soda.*

[Sent on from Denver, Col.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 1.38 |
| Water of combination, | .99 |
| Sulphuric acid, | 54.93 |
| Insoluble matter, | .16 |

### 5. ANALYSES, ETC. — *Continued.*

### *Nitrate of Soda.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 1.82 |
| Nitrogen, | 14.72 |
| Insoluble matter, | .12 |

### *Carbonate of Potash.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Water of combination, | 26.88 |
| Potassium oxide, | 18.48 |
| Magnesium oxide, | 19.52 |
| Insoluble matter, | .39 |

### *Odorless Phosphate.*

[I., sent on from Hatfield, Mass.; II., sent on from Marshfield, Mass.; III., sent on from Amherst, Mass.]

| | PER CENT. | | |
|---|---|---|---|
| | I. | II. | III. |
| Moisture at 100° C., | 1.12 | .60 | .63 |
| Potassium oxide, | .32 | .52 | –* |
| Phosphoric acid, | 18.40 | 19.45 | 18.42 |
| Calcium oxide, | 49.00 | 61.30 | 48.27 |
| Carbonic acid, | 2.67 | 2.25 | – |
| Insoluble matter, | 7.20 | 5.12 | 5.53 |

### *Concentrated Phosphates.*

[I., double superphosphate; II., phosphate of ammonia; III., phosphate of potash; sent on from New York, N. Y.]

| | PER CENT | | |
|---|---|---|---|
| | I. | II. | III |
| Moisture at 100° C., | 5.74 | 6.05 | 3.76 |
| Potassium oxide, | – | – | 32.56 |
| Calcium oxide, | 16.00 | – | – |
| Total phosphoric acid, | 47.80 | 43.86 | 35.70 |
| Soluble phosphoric acid, | 38.38 | –* | –* |
| Reverted phosphoric acid, | 9.04 | –* | –* |
| Insoluble phosphoric acid, | .38 | –* | –* |
| Nitrogen, | – | 10.37 | – |
| Insoluble matter, | .60 | .82 | .92 |

* Not determined.

## 5. ANALYSES, ETC. — *Continued.*

### *Florida Phosphates.*

[Sent on from Amherst, Mass.]

| | PER CENT. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | .95 | 2.52 |
| Total phosphoric acid, | 23.87 | 21.72 |
| Soluble phosphoric acid, | .16 | –* |
| Reverted phosphoric acid, | 1.37 | –* |
| Insoluble phosphoric acid, | 22.34 | –* |
| Insoluble matter, | 31.77 | 30.50 |

### *South Carolina Floats.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | .83 |
| Total phosphoric acid, | 23.39 |
| Soluble phosphoric acid, | Trace |
| Reverted phosphoric acid, | 2.33 |
| Insoluble phosphoric acid, | 21.06 |
| Insoluble matter, | 20.16 |

### *Ground Bone.*

[I., sent on from New Bedford, Mass.; II., sent on from Peabody, Mass.; III., sent on from Northborough, Mass ]

| | PER CENT. | | |
|---|---|---|---|
| | I. | II. | III. |
| Moisture at 100° C., | 5.94 | 4.62 | 4.85 |
| Total phosphoric acid, | 25.33 | 25.68 | 22.96 |
| Soluble phosphoric acid, | .32 | .52 | .29 |
| Reverted phosphoric acid. | 15.16 | 18.23 | 9.77 |
| Insoluble phosphoric acid, | 9.85 | 6.93 | 12.90 |
| Nitrogen, | 2.96 | 2.18 | 4.02 |
| Insoluble matter, | 1.02 | –* | .70 |

---

* Not determined.

## 5. ANALYSES, ETC. — *Continued.*

### *Ground Bone.*

[Sent on from Concord, Mass.]

| | PER CENT. | | |
|---|---|---|---|
| | I. | II. | III. |
| Moisture at 100° C., | 9.23 | 8.71 | 3.21 |
| Total phosphoric acid, | 21.80 | 20.29 | 23.46 |
| Soluble phosphoric acid, | – | – | .47 |
| Reverted phosphoric acid, | 12.96 | 10.20 | 12.21 |
| Insoluble phosphoric acid, | 8.84 | 10.09 | 10.78 |
| Nitrogen, | 3.54 | 3.70 | 3.22 |

### *Cotton-seed Meal.*

[I., II. and III., sent on from Amherst, Mass.; IV. and V., sent on from Hatfield, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 8.65 | 7.78 | 6.48 | 6.47 | 7.08 |
| Potassium oxide, | 2.25 | 1.78 | 2.50 | –* | –* |
| Phosphoric acid, | 3.17 | 3.15 | 2.58 | –* | –* |
| Nitrogen, | 6.50 | 6.24 | 6.88 | 7.23 | 6.62 |

* Not determined.

### *Mill Sweepings.*

[Sent on from Westborough, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 9.49 |
| Potassium oxide, | .66 |
| Phosphoric acid, | 1.18 |
| Nitrogen, | 3.76 |
| Insoluble matter, | 5.01 |

### *Home-mixed Fertilizers.*

[I., animal meal and tankage; II., tankage and potash, sent on from Eastham, Mass.]

| | PER CENT. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 3.20 | 6.20 |
| Potassium oxide, | – | 6.75 |
| Phosphoric acid, | 19.71 | 15.35 |
| Nitrogen, | 4.48 | 3.93 |

### 5. ANALYSES, ETC. — *Concluded.*

### *Animal Fertilizers.*

[I., sent on from New Bedford, Mass.; II., sent on from Boston, Mass.]

| | PER CENT. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 4.69 | 12.87 |
| Total phosphoric acid, | 13.22 | 9.08 |
| Soluble phosphoric acid, | .19 | –* |
| Reverted phosphoric acid, | 7.72 | –* |
| Insoluble phosphoric acid, | 5.31 | –* |
| Nitrogen, | 1.75 | 8.16 |
| Insoluble matter, | 11.92 | – |

* Not determined.

### *Complete Fertilizers.*

[I., sent on from Cleveland, Ohio; II., sent on from South Sudbury, Mass.; III., sent on from Springfield, Mass.; IV., sent on from West Berlin, Mass.]

| | PER CENT. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 8.50 | 11.25 | 12.47 | 11.03 |
| Total phosphoric acid, | 6.13 | 11.83 | 14.14 | 12.77 |
| Soluble phosphoric acid, | .32 | 2.30 | 1.85 | 7.52 |
| Reverted phosphoric acid, | 5.30 | 8.95 | 9.78 | 3.24 |
| Insoluble phosphoric acid, | .51 | .58 | 2.51 | 2.01 |
| Potassium oxide, | 6.68 | 2.44 | 7.22 | 1.40 |
| Nitrogen, | 4.53 | 4.69 | 4.11 | 2.39 |

### *Complete Fertilizers.*

[I. and II., sent on from North Hadley, Mass.; III. and IV., sent on from Hudson, Mass.]

| | PER CENT. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 6.00 | 7.62 | 9.87 | 4.34 |
| Total phosphoric acid, | 8.60 | 9.77 | 12.54 | 11.16 |
| Soluble phosphoric acid, | 3.74 | 3.22 | 4.96 | 4.76 |
| Reverted phosphoric acid, | 2.51 | 3.58 | 4.30 | 3.38 |
| Insoluble phosphoric acid, | 2.35 | 2.97 | 3.28 | 3.02 |
| Potassium oxide, | 5.59 | 6.64 | 5.99 | 6.66 |
| Nitrogen, | 2.29 | 2.46 | 3.20 | 3.94 |

## 6. MISCELLANEOUS ANALYSES.

### *Oriental Fertilizer and Bug Destroyer.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 87.14 |
| Solid matter, | 12.86 |
| Arsenic oxide, | 2.38 |
| Potassium oxide, | 3.50 |
| Sodium oxide, | 6.08 |
| Nitrogen, | .67 |
| Chlorine, | 3.00 |
| Sulphuric acid, | .64 |

### *Non-poisonous Potato-bug Destroyer.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | None |
| Nitrogen, | .08 |
| Ash, | 79.85 |
| Potassium oxide, | None |
| Calcium oxide, | 68.20 |
| Magnesium oxide, | 7.29 |
| Ferric and aluminic oxides, | 1.38 |
| Phosphoric acid, | Trace |
| Insoluble matter (before calcination), | 7.29 |
| Insoluble matter (after calcination), | 1.50 |

### *Clay (so called).*

[Sent on from Lynn, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | .70 |
| Calcium oxide, | 54.35 |
| Magnesium oxide, | 1.04 |
| Ferric and aluminic oxides, | 2.80 |
| Phosphoric acid, | Trace |
| Carbonic acid, | 37.30 |
| Organic and volatile matter, | 40.65 |
| Insoluble matter, | 2.57 |

## 6. MISCELLANEOUS ANALYSES — *Concluded.*

### *Soil.*

[Sent on from Springfield, Mass.]

| | PER CENT. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 2.39 | 8.15 |
| Potassium oxide, | .21 | .15 |
| Calcium oxide, | .56 | .54 |
| Phosphoric acid, | .18 | .16 |
| Nitrogen, | .154 | .147 |

### *Wheat Flour.*

[From station barn.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 14.46 |
| Potassium oxide, | .179 |
| Phosphoric acid, | .230 |
| Nitrogen, | 1.840 |

### *Buttermilk.*

[Sent on from Shelburne, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 91.130 |
| Nitrogen, | .510 |
| Ash, | .810 |
| Potassium oxide, | .046 |
| Phosphoric acid, | .041 |
| Calcium oxide, | .045 |

## 7. MISCELLANEOUS FODDER ANALYSES.

[I., corn ensilage, sent on from Marlborough, Mass.; II., oat and pea ensilage, sent on from Marlborough, Mass.; III., corn ensilage, sent on from Amherst, Mass.; IV., ensilage of *Panicum miliaceum*, sent on from Amherst, Mass.; V., ensilage of *Panicum crus-galli*, sent on from Amherst, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., . . | 79.98 | 38.02 | 71.27 | 78.01 | 76.75 |
| Dry matter, . . . . . | 20.02 | 61.98 | 28.73 | 21.99 | 23.25 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, . . . . . | 5.50 | 9.19 | 6.05 | 8.32 | 8.57 |
| " cellulose, . . . | 25.24 | 31.34 | 22.89 | 31.80 | 36.93 |
| " fat, . . . . . | 3.20 | 3.94 | 4.86 | 3.34 | 2.74 |
| " protein, . . . . | 8.22 | 13.72 | 10.00 | 7.46 | 7.89 |
| Nitrogen-free extract matter, . | 57.84 | 41.81 | 56.20 | 49.08 | 43.87 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

[I., millet (*Panicum crus-galli*), sent on from Amherst, Mass.; II., soja bean (late), sent on from Amherst, Mass.; III., soja bean (early green), sent on from Amherst, Mass.; IV., soja bean (early white), sent on from Amherst, Mass.; V., soja bean (medium black), sent on from Amherst, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV | V. |
| Moisture at 100° C., . . | 75.11 | 79.78 | 69.84 | 66.56 | 76.87 |
| Dry matter, . . . . . | 24.89 | 20.22 | 30.16 | 33.44 | 23.13 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, . . . . . | 9.75 | 21.33 | 12.97 | 15.25 | 12.66 |
| " cellulose, . . . | 29.51 | 23.62 | 23.51 | 27.12 | 21.73 |
| " fat, . . . . . | 2.79 | 2.25 | 3.87 | 2.77 | 6.76 |
| " protein, . . . . | 11.45 | 18.56 | 19.35 | 17.63 | 21.67 |
| Nitrogen-free extract matter, . | 46.50 | 34.24 | 40.40 | 37.23 | 37.18 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

## 7. MISCELLANEOUS FODDER ANALYSES — *Continued.*

[I., soja-bean straw, sent on from Amherst, Mass.; II., Japanese radish (*merinia*), sent on from Amherst, Mass.; III., Japanese radish (*niyashige*), sent on from Amherst, Mass.; IV., soja-bean meal, sent on from Amherst, Mass.; V., cotton-seed hulls, sent on from Boston, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 13.97 | 93.26 | 92.58 | 10.80 | 8.15 |
| Dry matter, | 86.03 | 6.74 | 6.74 | 89.20 | 91.85 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 5.57 | 10.32 | 9.87 | 5.04 | 2.81 |
| " cellulose, | 46.51 | 10.27 | 9.79 | 5.01 | 46.60 |
| " fat, | 1.17 | 1.05 | .96 | 18.17 | 1.79 |
| " protein, | 5.73 | 7.47 | 6.51 | 41.18 | 4.10 |
| Nitrogen-free extract matter, | 41.02 | 70.89 | 72.87 | 30.60 | 44.70 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

[I., ground oats, sent on from Baldwinville, Mass.; II., wheat bran, sent on from Amherst, Mass.; III., dried brewers' grain, sent on from Boston, Mass.; IV., new-process linseed meal, sent on from North Amherst, Mass.; V., cotton-seed meal, sent on from Amherst, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 9.71 | 9.85 | 7.99 | 10.19 | 6.48 |
| Dry matter, | 90.29 | 90.15 | 92.01 | 89.81 | 93.52 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 3.93 | 7.11 | –* | –* | 7.16 |
| " cellulose, | 9.29 | 11.82 | –* | –* | 5.60 |
| " fat, | 3.51 | 5.30 | 6.04 | 2.89 | 11.04 |
| " protein, | 13.20 | 18.17 | 18.74 | 38.84 | 46.08 |
| Nitrogen-free extract matter, | 70.07 | 57.60 | –* | –* | 30.12 |
| | 100.00 | 100.00 | – | – | 100.00 |

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* Not determined.

## 7. MISCELLANEOUS FODDER ANALYSES — *Continued.*

[I., Richardson glucose feed, sent on from Amherst, Mass.; II., glucose refuse, sent on from Boston, Mass.; III., starch feed (Pope), sent on from Amherst, Mass.; IV., rye feed, sent on from North Dartmouth, Mass.; V., oat feed, sent on from Baldwinville, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 6.32 | 6.71 | 5.48 | 9.63 | 9.47 |
| Dry matter, | 93.68 | 93.29 | 94.52 | 90.37 | 90.53 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 1.13 | 1.20 | .90 | 2.62 | 3.98 |
| " cellulose, | 5.00 | 4.77 | 15.21 | 3.52 | 8.06 |
| " fat, | 11.67 | 10.55 | 11.30 | 2.79 | 4.28 |
| " protein, | 23.12 | 21.06 | 11.28 | 13.56 | 15.60 |
| Nitrogen-free extract matter, | 59.08 | 62.42 | 61.31 | 77.51 | 69.08 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

[I., proteina, sent on from North Amherst, Mass.; II., proteina, sent on from Weston, Mass.; III., proteina, sent on from Bolton, Mass.; IV., cooked feed (oats and corn), sent on from Worcester, Mass.; V., excelsior feed, sent on from Holden, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 8.04 | 6.80 | 8.63 | 5.55 | 7.08 |
| Dry matter, | 91.96 | 93.20 | 91.31 | 94.45 | 92.92 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 2.80 | 3.24 | 2.13 | 4.04 | 4.43 |
| " cellulose, | 12.33 | 10.18 | –* | 8.73 | 14.65 |
| " fat, | 7.74 | 8.24 | 8.53 | 5.34 | 5.42 |
| " protein, | 24.47 | 27.23 | 24.57 | 14.75 | 9.75 |
| Nitrogen-free extract matter, | 52.66 | 51.11 | –* | 67.14 | 65.75 |
| | 100.00 | 100.00 | – | 100.00 | 100.00 |

* Not determined.

## 7. MISCELLANEOUS FODDER ANALYSES — *Continued.*

[I., gluten feed (Pope), sent on from Amherst, Mass.; II., gluten feed, sent on from Marlborough, Mass.; III. and IV., gluten feed, sent on from Amherst, Mass.; V., gluten feed, sent on from Sunderland, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 13.98 | 7.64 | 8.06 | 8.99 | 9.39 |
| Dry matter, | 86.02 | 92.36 | 91.94 | 91.01 | 90 61 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | .75 | 1.14 | –* | –* | –* |
| " cellulose, | 1.80 | 5.78 | –* | –* | –* |
| " fat, | 16.34 | 9.18 | 7.57 | 7.71 | 13.71 |
| " protein, | 38.68 | 21.11 | 27.19 | 27.33 | 27.45 |
| Nitrogen-free extract matter, | 42.43 | 62.79 | –* | –* | –* |
| | 100.00 | 100.00 | – | – | – |

[I., gluten meal, sent on from North Amherst, Mass.; II., gluten meal, sent on from Agawam, Mass.; III., gluten meal, sent on from Sunderland, Mass.; IV., gluten meal, sent on from South Acton, Mass.; V., gluten meal, sent on from Boston, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 6.93 | 5.93 | 6.85 | 7.29 | 6.15 |
| Dry matter, | 93.07 | 94.07 | 93.15 | 92.71 | 93.85 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | .69 | .50 | –* | –* | –* |
| " cellulose, | 9.08 | 5.80 | –* | –* | –* |
| " fat, | 9.81 | 12.08 | 10.67 | 7.07 | 16.52 |
| " protein, | 14.51 | 30.63 | 25.43 | 32.56 | 29.47 |
| Nitrogen-free extract matter, | 65.91 | 50.99 | –* | –* | –* |
| | 100.00 | 100.00 | – | – | – |

* Not determined.

### 7. MISCELLANEOUS FODDER ANALYSES — *Concluded.*

[I., pea bran, sent on from Great Barrington, Mass.; II., Louisiana rice bran, sent on from Sudbury, Mass.; III., bran, sent on from South Acton, Mass.; IV., oat meal and barley refuse, sent on from Amherst, Mass.; V., cranberries, sent on from Amherst, Mass.]

| | PER CENT. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 7.14 | 10.25 | 6.67 | 7.76 | 89.41 |
| Dry matter, | 92.86 | 89.75 | 93.33 | 92.24 | 10.59 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 3.33 | 10.59 | -* | 3.84 | 1.99 |
| " cellulose, | 46.16 | 14.86 | -* | 22.30 | 11.63 |
| " fat, | 1.16 | 9.66 | 5.04 | 3.80 | 5.61 |
| " protein, | 10.31 | 9.82 | 17.88 | 7.45 | 4.40 |
| Nitrogen-free extract matter, | 39.04 | 55.07 | -* | 62.61 | 76.37 |
| | 100.00 | 100.00 | - | 100.00 | 100.00 |

* Not determined.

## II.

### ANALYSES OF MILK SENT ON FOR EXAMINATION.

[Per Cent.]

| NUMBER OF SAMPLE. | Solids. | Fat. | Solids not Fat. | Locality. | Remarks. |
|---|---|---|---|---|---|
| 1, . . | 11.77 | 3.03 | 8.74 | Westborough. | |
| 2, . . | 12.29 | 3.37 | 8.92 | Westborough. | |
| 3, . . | 12.83 | 3.61 | 9.22 | Marblehead. | |
| 4, . . | 13.19 | 3.93 | 9.26 | Marblehead. | |
| 5, . . | 12.24 | 3.38 | 8.86 | Berlin. | |
| 6, . . | 13.30 | 4.62 | 8.68 | Barre. | |
| 7, . . | 11.71 | 3.36 | 8.35 | Furnace. | |
| 8, . . | 10.34 | 3.11 | 7.23 | Northampton. | |
| 9, . . | 12.98 | 3.90 | 9.08 | Barre Plains. | |
| 10, . . | 12.78 | 3.80 | 8.98 | Barre Plains. | |
| 11, . . | 10.53 | 1.28 | 9.25 | Barre Plains. | |
| 12, . . | 14.11 | 5.07 | 9.04 | Barre Plains. | |
| 13, . . | 4.62 | .28 | 3.43 | Amherst. | Whey. |
| 14, . . | 6.32 | – | – | Adams. | Whey. |
| 15, . . | 12.60 | 3.36 | 9.24 | Westborough. | |
| 16, . . | 12.70 | 3.50 | 9.20 | Gilbertville. | |
| 17, . . | 12.53 | 4.02 | 8.51 | Furnace. | |
| 18, . . | 13.29 | 4.27 | 9.03 | Barre Plains. | |
| 19, . . | 12.06 | 3.21 | 8.85 | Granby. | |
| 20, . . | 9.24 | .30 | 8.94 | Granby. | Skim-milk |
| 21, . . | 12.50 | 3.81 | 8.69 | Gilbertville. | |
| 22, . . | 13.07 | 4.31 | 8.76 | Barre. | |
| 23, . . | 13.43 | 4.48 | 8.95 | Barre Plains. | |
| 24, . . | 12.66 | 3.81 | 8.85 | New Braintree. | |
| 25, . . | 11.68 | 1.80 | 9.80 | Westborough. | |
| 26, . . | 11.76 | 2.05 | 9.71 | Westborough. | |

## III.

## Analyses of Water sent on for Examination.*

[Parts per million.]

| Number. | Actual Ammonia. | Albuminoid Ammonia. | Chlorine. | Solids at 100° C. | Solids at Red Heat. | Hardness (Clark's Degree). | Lead. | Locality. |
|---|---|---|---|---|---|---|---|---|
| 1 | .012 | .140 | 2.00 | 108.00 | 50.00 | 1.11 | - | Barre. |
| 2 | .052 | .128 | 26.00 | 112.00 | 72.00 | 2.08 | - | North Amherst. |
| 3 | .012 | .072 | 3.00 | 88.00 | 56.00 | - | - | Barre. |
| 4 | .248 | .220 | 4.00 | 192.00 | 92.00 | 3.38 | - | East Amherst. |
| 5 | .028 | .084 | 6.00 | 104.00 | 48.00 | 3.25 | - | Amherst. |
| 6 | .088 | .144 | 4.00 | 170.00 | 82.00 | 2.34 | None. | Littleton. |
| 7 | .008 | .140 | 7.00 | 70.00 | 36.00 | .79 | - | Prescott. |
| 8 | .016 | .092 | 6.00 | 116.00 | 60.00 | 2.34 | None. | Littleton. |
| 9 | .012 | .152 | 4.00 | 112.00 | 44.00 | .63 | None. | Littleton. |
| 10 | .052 | .360 | 18.00 | 180.00 | 60.00 | 2.60 | - | Upton. |
| 11 | .080 | .160 | 8.00 | 100.00 | 40.00 | 2.08 | - | Leverett. |
| 12 | .076 | .316 | 15.00 | 330.00 | 130.00 | 6.86 | - | Westminster. |
| 13 | Trace. | .340 | 15.00 | 740.00 | 316.00 | 46.60 | - | Weston. |
| 14 | .012 | .104 | 8.00 | 120.00 | 40.00 | 1.95 | - | Weston. |
| 15 | .020 | .180 | 14.00 | 120.00 | 36.00 | 2.73 | - | Nichawong. |
| 16 | .048 | .084 | 25.00 | 220.00 | 56.00 | 5.29 | - | Globe Village. |
| 17 | 1.660 | .760 | 43.00 | 366.00 | 126.00 | 7.43 | - | Globe Village. |
| 18 | .016 | .080 | 34.00 | 310.00 | 100.00 | 6.43 | - | Globe Village. |
| 19 | .028 | .080 | 14.00 | 126.00 | 46.00 | 4.03 | - | Framingham. |
| 20 | Trace. | .104 | 10.00 | 238.00 | 74.00 | 5.71 | None. | Amherst. |
| 21 | .028 | .092 | 6.00 | 120.00 | 56.00 | 4.57 | - | Plainfield. |
| 22 | .184 | .336 | 16.00 | 200.00 | 84.00 | 5.86 | - | East Templeton. |
| 23 | .660 | .268 | 34.00 | 310.00 | 70.00 | 10.75 | - | Templeton. |
| 24 | .136 | .192 | 76.00 | 220.00 | 100.00 | 11.50 | - | Charlton Depot. |
| 25 | Trace. | .116 | 2.00 | 128.00 | 50.00 | 1.56 | - | Chatham. |
| 26 | .568 | .152 | 40.00 | 286.00 | 130.00 | 10.60 | - | Amherst. |

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* Analysis of well water at the station is confined to chemical tests with reference to an excess of foreign matter from sinks, barns, etc.

## Analyses of Water, etc. — *Continued.*

| Number. | Actual Ammonia. | Albuminoid Ammonia. | Chlorine. | Solids at 100° C. | Solids at Red Heat | Hardness (Clark's Degree). | Lead. | Locality. |
|---|---|---|---|---|---|---|---|---|
| 27 | .776 | .172 | 40.00 | 300.00 | 60.00 | 8.86 | - | Concord. |
| 28 | .300 | .240 | 224.00 | 956.00 | 200.00 | 10.90 | - | Concord. |
| 29 | .160 | .240 | 10.00 | 200.00 | 60.00 | 1.56 | - | Concord. |
| 30 | .056 | .108 | 6.00 | - | - | 1.43 | - | Amherst. |
| 31 | .072 | .100 | 26.00 | 220.00 | 100.00 | 5.43 | - | Amherst. |
| 32 | .672 | .308 | 98.00 | 640.00 | 200.00 | 9.43 | - | Amherst. |
| 33 | .044 | .096 | 50.00 | 360.00 | 100.00 | 10.00 | - | Concord. |
| 34 | .116 | .168 | 66.00 | 340.00 | 90.00 | 10.75 | - | Concord. |
| 35 | .064 | .248 | 36.00 | 240.00 | 80.00 | 4.71 | - | Concord. |
| 36 | .100 | .184 | 36.00 | 410.00 | 130.00 | 7.43 | - | Concord. |
| 37 | .024 | .176 | 12.00 | 140.00 | 56.00 | 4.29 | - | South Acton. |
| 38 | Trace. | .092 | 8.00 | 256.00 | 80.00 | 7.43 | None. | South Acton. |
| 39 | .240 | .180 | 8.00 | 230.00 | 90.00 | 4.03 | - | South Amherst. |
| 40 | None. | .060 | 4.00 | 200.00 | 52.00 | 4.29 | - | Oakdale. |
| 41 | .040 | .064 | 20.00 | 200.00 | 40.00 | 1.95 | - | Amherst. |
| 42 | None. | .292 | 3.00 | 104.00 | 40.00 | 1.95 | - | South Deerfield. |
| 43 | .020 | .140 | 20.00 | 160.00 | 64.00 | 2.73 | - | Concord. |
| 44 | .040 | .124 | 6.00 | 120.00 | 72.00 | 1.95 | - | Concord. |
| 45 | .052 | .128 | 42.00 | 260.00 | 100.00 | 5.71 | - | Concord. |
| 46 | .044 | .136 | 15.00 | 160.00 | 92.00 | 2.21 | - | Concord. |
| 47 | Trace. | .160 | 22.00 | 240.00 | 100.00 | 4.86 | - | Barre. |
| 48 | .082 | .324 | 20.00 | 286.00 | 58.00 | 4.86 | - | Amherst. |
| 49 | .024 | .186 | 17.00 | 250.00 | 80.00 | 4.43 | - | Amherst. |
| 50 | .032 | .086 | 13.00 | 140.00 | 28.00 | 1.69 | - | Concord. |
| 51 | .372 | .100 | 7.00 | 144.00 | 86.00 | .48 | - | North Andover. |
| 52 | .344 | .326 | 8.00 | 128.00 | 52.00 | 1.11 | - | North Andover. |
| 53 | .080 | .184 | 15.00 | 236.00 | 100.00 | 4.03 | - | Shirley. |
| 54 | .036 | .266 | 4.00 | 96.00 | 54.00 | - | - | Amherst. |
| 55 | .022 | .256 | - | 62.00 | 36.00 | - | - | Amherst. |
| 56 | .078 | .160 | 6.00 | 64.00 | 14.00 | - | - | Amherst. |
| 57 | .028 | .120 | 24.00 | 224.00 | 120.00 | 5.14 | - | Amherst |
| 58 | .100 | .104 | 10.00 | 140.00 | 64.00 | 3.51 | - | Westfield. |
| 59 | .028 | .150 | 3.00 | 124.00 | 64.00 | 2.86 | - | South Deerfield. |
| 60 | .016 | .092 | 10.00 | 100.00 | 32.00 | 1.82 | - | Weston. |
| 61 | .060 | .132 | 11.00 | 112.00 | 44.00 | 2.60 | - | Weston. |

### ANALYSES OF WATER, ETC. — *Concluded.*

| NUMBER. | Actual Ammonia. | Albuminoid Ammonia. | Chlorine. | Solids at 100° C. | Solids at Red Heat. | Hardness (Clark's Degree). | Lead. | Locality. |
|---|---|---|---|---|---|---|---|---|
| 62 | .094 | .190 | 22.00 | 236.00 | 140.00 | 4.71 | - | Barre. |
| 63 | .072 | .164 | 8.00 | 200.00 | 52.00 | 2.47 | - | Wellesley Hills. |
| 64 | .204 | .244 | 4.00 | 132.00 | 48.00 | 1.11 | - | Petersham. |
| 65 | .052 | .120 | 7.00 | 110.00 | 32.00 | 2.08 | - | Chelmsford. |
| 66 | .032 | .244 | 3.00 | 160.00 | 90.00 | .79 | - | North Brookfield. |
| 67 | .032 | .084 | 14.00 | 152.00 | 42.00 | 1.95 | None. | North Amherst. |
| 68 | 3.200 | 1.300 | 35.00 | 260.00 | 44.00 | 6.00 | - | South Deerfield. |
| 69 | Trace. | .136 | 6.00 | 84.00 | 28.00 | 1.95 | - | Leverett. |
| 70 | .132 | .100 | 6.00 | 96.00 | 56.00 | .32 | - | South Sudbury. |
| 71 | .084 | .148 | 4.00 | 116.00 | 24.00 | - | - | South Deerfield. |
| 72 | 2.560 | 1.456 | 5.00 | 112.00 | 16.00 | 1.11 | - | South Deerfield. |
| 73 | .016 | .076 | 2.00 | 76.00 | 24.00 | 2.08 | - | Concord. |
| 74 | .020 | .096 | 4.00 | 60.00 | 24.00 | .16 | - | Amherst. |
| 75 | .272 | .296 | 4.00 | 136.00 | 96.00 | 1.69 | - | Littleton. |
| 76 | .040 | .144 | 18.00 | 160.00 | 72.00 | 1.69 | - | Littleton. |
| 77 | .272 | .208 | 7.00 | 176.00 | 92.00 | 3.25 | - | Littleton. |
| 78 | .040 | .088 | 8.00 | 120.00 | 36.00 | 2.60 | - | Littleton. |
| 79 | .036 | .068 | 24.00 | 240.00 | 140.00 | 5.43 | - | Littleton. |
| 80 | .240 | .200 | 4.00 | 260.00 | 120.00 | 6.86 | - | Littleton. |
| 81 | 2.400 | 1.300 | 33.00 | 276.00 | 52.00 | 6.57 | - | South Deerfield. |
| 82 | .032 | .152 | 2.00 | 100.00 | 36.00 | 2.60 | - | Holyoke. |
| 83 | .044 | .068 | 2.00 | 104.00 | 40.00 | 4.86 | - | Holyoke. |
| 84 | .036 | .172 | 2.00 | 76.00 | 32.00 | 2.21 | - | Holyoke. |
| 85 | .088 | .096 | 3.00 | 164.00 | 20.00 | 7.43 | - | Holyoke. |
| 86 | .020 | .084 | 6.00 | 168.00 | 32.00 | 5.86 | - | Framingham. |
| 87 | .012 | .108 | 3.00 | 136.00 | 72.00 | 3.38 | - | Chelmsford. |
| 88 | .028 | .096 | 20.00 | 184.00 | 44.00 | 2.99 | - | Westminster. |
| 89 | .020 | .084 | 7.00 | 220.00 | 108.00 | 3.25 | - | Littleton. |
| 90 | Trace. | .076 | 8.00 | 140.00 | 40.00 | 3.51 | - | Littleton. |
| 91 | .064 | .072 | 10.00 | 776.00 | 100.00 | 4.86 | - | Framingham. |
| 92 | .020 | .076 | 8.00 | 112.00 | 52.00 | 2.47 | - | Westminster. |
| 93 | .040 | .068 | 2.00 | 96.00 | 56.00 | 1.11 | - | Westminster. |

The analyses have been made according to Wanklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wanklyn and E. T. Chapman.)

Mr. Wanklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the previously stated analyses indicates that Nos. 4, 10, 11, 12, 13, 15, 17, 22, 23, 24, 26, 27, 28, 29, 32, 34, 35, 36, 37, 39, 42, 48, 49, 51, 52, 53, 54, 55, 56, 62, 63, 64, 66, 68, 72, 75, 77, 80, 81, 82 and 84 ought to be condemned as unfit for family use; while Nos. 1, 2, 6, 7, 9, 31, 47, 58, 59, 61, 65, 69, 70, 71, 76 and 85 must be considered suspicious. From this record it will be seen that one-half of the entire number of well waters tried proved unfit for drinking. Heating waters to the boiling point not unfrequently removes immediate danger.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

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* One gallon equals 70,000 grains.

# IV. COMPILATION OF ANALYSES MADE AT AMHERST, MASS., OF AGRICULTURAL CHEMICALS AND REFUSE MATERIALS USED FOR FERTILIZING PURPOSES.

PREPARED BY C. S. CROCKER.

[As the basis of valuation changes from year to year, no valuation is stated.]

## 1868-1894.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1893, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

| | Analyses. | Moisture. | Ash. | Nitrogen. | | | Potash. | | | Total Phosphoric Acid. | | | Soluble Phosphoric Acid. | Reverted Phosphoric Acid. | Insoluble Phosphoric Acid. | Soda. | Lime. | Magnesia. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | | | | | | | | | | | |
| *I. Chemicals, Refuse, Salts, Ashes, etc.* | | | | | | | | | | | | | | | | | | | | | | | |
| Muriate of potash, | 66 | 1.98 | - | - | - | - | 58.98 | 45.94 | 51.05 | - | - | - | - | - | - | 6.69 | - | .55 | - | - | - | 48.80 | .70 |
| Sulphate of potash, | 24 | 2.55 | - | - | - | - | 51.28 | 21.36 | 34.99 | - | - | - | - | - | - | 4.46 | - | 1.50 | - | 45.72 | - | - | .75 |
| Sulphate of potash magnesia, | 16 | 4.96 | - | - | - | - | 29.48 | 16.96 | 23.55 | - | - | - | - | - | - | 6.25 | 2.57 | - | - | 44.25 | - | 2.60 | 1.41 |
| Carbonate of potash, | 1 | 26.88 | - | - | - | - | - | - | 18.48 | - | - | - | - | - | - | - | - | 19.52 | - | - | - | - | .39 |
| Phosphate of potash, | 1 | 3.76 | - | - | - | - | - | - | 32.56 | - | - | 37.50 | - | - | - | - | - | - | - | 13.43 | - | - | .92 |
| Kainite, | 4 | 3.20 | - | - | - | - | 16.48 | 12.51 | 13.54 | - | - | - | - | - | - | 18.97 | 1.15 | 9.80 | - | 20.25 | - | 33.25 | 2.13 |
| Carnallite, | 1 | - | - | - | - | - | - | - | 13.68 | - | - | - | - | - | - | 7.66 | - | 13.19 | - | .56 | - | 41.56 | - |
| Krugite, | 1 | 4.82 | - | - | - | - | - | - | 8.42 | - | - | - | - | - | - | 5.27 | 12.45 | 8.79 | - | 31.94 | - | 6.63 | 14.96 |
| Sulphate of magnesia (Kieserite), | 9 | 22.70 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.82 | 17.30 | - | 36.10 | - | - | 5.73 |
| Nitrate of potash, | 4 | 1.30 | - | 14.58 | 11.60 | 12.71 | 45.62 | 44.76 | 45.27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Nitrate of soda, | 25 | 1.47 | - | 16.01 | 14.28 | 14.70 | - | - | - | - | - | - | - | - | - | 35.50 | - | - | - | - | - | .50 | .50 |
| Sulphate of ammonia, | 26 | 1.05 | - | 21.68 | 19.59 | 22.16 | - | - | - | - | - | - | - | - | - | - | - | - | - | 60.00 | - | - | - |
| Phosphate of ammonia, | 1 | 6.05 | - | - | - | 10.37 | - | - | - | - | - | 43.86 | - | - | - | - | - | - | - | 12.46 | - | - | .82 |
| Sulphate of soda, | 1 | 1.38 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 59.43 | - | - | - |
| Saltpetre waste, | 12 | 2.54 | - | 3.30 | .52 | 2.22 | 30.94 | 1.55 | 13.66 | - | - | - | - | - | - | 37.04 | .75 | .19 | - | 1.85 | - | 46.25 | - |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitre salt-cake, | 2 | 6.03 | - | - | - | 2.29 | - | - | .87 | - | - | - | - | - | - | 29.56 | - | - | - | 47.77 | - | - | 3.92 |
| Wood ashes, | 329 | 12.75 | - | - | - | - | 10.80 | 2.32 | 5.33 | 5.58 | .05 | 1.59 | - | - | - | - | 33.73 | 3.31 | .96 | - | - | - | 14.12 |
| Cotton-seed-hull ashes, | 40 | 8.15 | - | - | - | - | 42.12 | 9.91 | 22.48 | 13.67 | 2.89 | 8.40 | - | - | - | - | 9.33 | 10.47 | 1.71 | - | - | - | 13.32 |
| Ashes of spent tan-bark, | 5 | 4.84 | - | - | - | - | 2.87 | .60 | 1.81 | 2.77 | .13 | 1.36 | - | - | - | - | 31.11 | 3.39 | 1.78 | - | - | - | 25.21 |
| Corn-cob ashes, | 1 | 1.20 | - | - | - | - | - | - | 7.08 | - | - | 2.37 | - | - | - | - | 11.70 | - | 1.28 | - | - | - | 52.09 |
| Railroad-tie ashes, | 1 | 4.70 | - | - | - | - | - | - | .92 | - | - | .56 | - | - | - | - | 2.51 | - | - | - | - | - | 80.20 |
| Peat ashes, | 1 | 4.67 | - | - | - | - | - | - | .46 | - | - | .11 | - | - | - | - | 2.28 | 1.63 | 6.13 | - | - | - | 45.17 |
| Logwood ashes, | 2 | 1.10 | - | - | - | - | .08 | - | .04 | .70 | .11 | .40 | - | - | - | - | 31.09 | 1.46 | 1.46 | - | 32.95 | - | 3.09 |
| Hard-pine wood ashes, | 1 | .75 | - | - | - | - | - | - | 10.16 | - | - | 2.24 | - | - | - | - | 24.95 | - | - | - | - | - | 29.90 |
| Mill ashes, | 1 | .53 | - | - | - | - | - | - | 1.60 | - | - | .46 | - | - | - | - | 34.93 | 1.35 | - | - | - | - | 36.36 |
| Swill ashes, | 4 | .18 | - | - | - | - | 8.83 | 1.25 | 4.71 | 32.36 | 16.61 | 23.06 | - | - | - | - | 33.58 | 1.87 | 4.65 | - | - | - | 17.74 |
| Ashes from blue works, | 1 | 12.14 | 63.78 | - | - | - | - | - | 9.02 | - | - | - | - | - | - | - | - | - | - | - | - | - | 12.30 |
| Sea-weed ashes, | 1 | 1.47 | - | - | - | - | - | - | .92 | - | - | .30 | - | - | - | 8.76 | 6.06 | 4.37 | - | 2.98 | - | 6.60 | 63.65 |
| Gypsum, | 3 | 13.30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 32.86 | - | - | 48.01 | - | - | .59 |
| Gypse, | 1 | 1.64 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 50.87 | - | - | - | - | - | 2.87 |
| Nova Scotia plaster, | 10 | 6.50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 33.85 | .75 | - | 45.75 | - | - | 2.50 |
| Onondaga plaster, | 4 | 13.27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 30.00 | 4.66 | - | 32.50 | 8.20 | - | 9.83 |
| Lime, | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 96.10 | - | - | - | - | - | 1.33 |
| Gas-house lime, | 3 | 22.28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 43.66 | 8.30 | - | 20.73 | - | - | 6.05 |
| Lime waste from sugar factory, | 1 | 36.30 | - | - | - | - | - | - | .22 | - | - | 2.25 | - | - | - | - | 27.51 | - | - | - | - | - | .32 |
| Lime-kiln ashes, | 11 | 15.90 | - | - | - | - | 2.12 | .02 | 1.15 | 3.16 | .36 | 1.02 | - | - | - | - | 42.17 | 2.60 | - | - | 17.75 | - | 7.87 |
| Marls (Massachusetts), | 7 | 13.70 | - | - | - | - | - | - | .24 | 2.72 | .06 | 1.05 | - | - | - | - | 40.50 | .64 | .69 | - | 28.57 | - | 3.44 |

| | Analyses. | Moisture. | Ash. | Nitrogen. | | | Potash. | | | Total Phosphoric Acid. | | | Soluble Phosphoric Acid. | Reverted Phosphoric Acid. | Insoluble Phosphoric Acid. | Soda. | Lime. | Magnesia. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | | | | | | | | | | | |
| *I. Chemicals, Refuse, Salts, Ashes, etc.* —Concluded. | | | | | | | | | | | | | | | | | | | | | | | |
| Marls (Virginia), | 2 | 15.98 | - | - | - | - | .61 | .37 | .49 | .09 | .08 | .09 | - | - | - | - | 7.25 | .21 | - | .66 | 7.25 | - | 64.23 |
| Greens and marl (Virginia), | 1 | 1.25 | - | - | - | - | - | - | 1.14 | - | - | 9.37 | - | - | - | - | 25.78 | - | 5.13 | - | - | - | 41.32 |
| Olive earth (Virginia), | 1 | 1.97 | - | - | - | - | - | - | .24 | - | - | 13.73 | - | - | - | - | 19.16 | - | 6.00 | - | - | - | 50.55 |
| Ammoniated marl, | 1 | 3.31 | - | - | - | 1.61 | - | - | - | - | - | 10.39 | - | .41 | 9.98 | - | - | - | - | - | - | - | - |
| Marl (North Carolina), | 1 | 1.50 | - | - | - | - | - | - | .04 | - | - | .56 | - | - | - | - | 21.95 | .61 | - | - | - | - | 50.18 |
| Clay (so called), | 1 | .70 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 54.35 | 1.04 | 2.80 | - | 37.32 | - | 2.57 |
| *II. Guanos, Phosphates, etc.* | | | | | | | | | | | | | | | | | | | | | | | |
| Peruvian guano, | 26 | 14.81 | 37.61 | 13.50 | 4.44 | 7.85 | 4.08 | 1.14 | 2.61 | 20.60 | 5.96 | 15.26 | 4.57 | 3.79 | 6.90 | - | - | - | - | - | - | - | 6.60 |
| Bat guano from Texas, | 9 | 40.09 | 18.24 | 10.51 | 2.58 | 6.47 | - | - | 1.31 | 6.53 | 1.00 | 3.76 | - | - | - | - | - | - | - | - | - | - | 2.00 |
| Bat guano from Florida, | 2 | 15.66 | - | - | - | 9.74 | - | - | 1.77 | 3.44 | 3.26 | 3.35 | - | - | - | - | - | - | - | - | - | - | 19.33 |
| Rat guano from Florida, | 1 | 10.32 | - | - | - | 3.32 | - | - | 6.85 | - | - | 2.30 | - | - | - | - | - | - | - | - | - | - | 1.15 |
| Cuba guano, | 5 | 24.27 | - | 2.74 | .63 | 1.67 | - | - | - | 16.16 | 11.54 | 13.35 | - | - | - | - | - | - | - | - | - | - | 3.17 |
| Caribbean guano (orchilla), | 12 | 7.31 | - | - | - | - | - | - | - | 35.43 | 18.11 | 26.77 | - | - | - | - | 39.95 | 3.29 | - | 2.68 | - | - | 1.27 |
| Mona Island guano, | 1 | 13.32 | - | - | - | .76 | - | - | - | - | - | 21.88 | - | 7.55 | 14.33 | - | 37.49 | - | - | - | - | - | 2.45 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Carolina rock phosphate, | 6 | 1.45 | - | - | - | - | - | - | - | 30.51 | 24.70 | 27.47 | .27 | .07 | 27.13 | - | 41.87 | 3.03 | 4.80 | - | - | - | 9.04 |
| South Carolina floats, | 1 | .83 | - | - | - | - | - | - | - | - | - | 23.39 | - | 2.33 | 21.06 | - | - | - | - | - | - | - | 20.16 |
| Florida rock phosphate, | 27 | 2.07 | - | - | - | - | - | - | - | 38.97 | 6.95 | 26.78 | - | - | - | - | 30.32 | - | 7.59 | - | - | - | 27.49 |
| Soft Florida phosphate, | 1 | 2.24 | - | - | - | - | - | - | - | - | - | 17.71 | - | - | - | - | 14.64 | - | 6.72 | - | - | - | 13.37 |
| Navassa phosphate, | 2 | 7.60 | - | - | - | - | - | - | - | 34.45 | 34.09 | 34.27 | - | - | - | - | 37.45 | - | 10.27 | - | - | - | 2.70 |
| Brockville phosphate, | 1 | 2.50 | - | - | - | - | - | - | - | - | - | 35.21 | - | - | - | - | - | - | - | - | - | - | 6.46 |
| Phosphatic slag, | 4 | 1.45 | - | - | - | - | - | - | - | 30.51 | 18.91 | 23.49 | - | 3.06 | 21.65 | - | 48.66 | 3.42 | 10.12 | - | - | - | 9.40 |
| Odorless phosphate, | 3 | 3.35 | - | - | - | - | .52 | .32 | .42 | 19.45 | 18.40 | 18.75 | - | - | - | - | 52.85 | - | - | - | 2.51 | - | 5.90 |
| Dissolved bone-black, | 4 | 11.14 | 47.50 | - | - | - | - | - | - | 17.54 | 15.35 | 16.04 | 14.56 | 1.12 | .36 | - | - | - | - | - | - | - | 3.46 |
| Bone-black, | 5 | 4.60 | - | - | - | - | - | - | - | 30.54 | 16.56 | 28.28 | - | - | - | - | - | - | - | - | - | - | 3.64 |
| Double superphosphate, | 1 | 5.74 | - | - | - | - | - | - | - | - | - | 47.80 | 38.38 | 9.04 | .38 | - | 16.00 | - | - | 1.19 | - | - | .60 |
| South American bone-ash, | 1 | 7.00 | - | - | - | - | - | - | - | - | - | 35.89 | - | - | - | - | 44.89 | - | - | - | - | - | 4.50 |
| Acid phosphate, | 1 | 14.23 | 69.95 | - | - | - | - | - | - | - | - | 14.64 | 10.34 | 2.42 | 1.88 | - | - | - | - | - | - | - | 10.81 |
| *III. Refuse Substances.* | | | | | | | | | | | | | | | | | | | | | | | |
| Dried blood, | 16 | 12.23 | 6.37 | 13.55 | 8.10 | 10.51 | - | - | - | 6.23 | 1.53 | 2.05 | - | - | - | - | - | - | - | - | - | - | - |
| Ammonite, | 1 | 5.88 | - | - | - | 11.33 | - | - | - | - | - | 3.43 | - | - | - | - | - | - | - | - | - | - | 1.38 |
| Oleomargarine refuse, | 1 | 8.54 | 14.42 | - | - | 12.12 | - | - | - | - | - | .88 | - | - | - | - | - | - | - | - | - | - | .96 |
| Felt refuse, | 1 | 29.24 | 33.53 | - | - | 5.26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Sponge refuse, | 1 | 7.25 | - | - | - | 2.43 | - | - | - | - | - | 3.19 | - | - | - | - | 3.94 | 1.27 | - | - | - | - | 39.05 |
| Horn shavings, | 1 | 4.83 | - | - | - | 15.31 | - | - | - | - | - | .42 | - | - | - | - | - | - | - | - | - | - | - |
| Ivory dust, | 1 | 11.50 | 52.63 | - | - | 6.64 | - | - | - | - | - | 24.56 | .97 | 17.97 | 5.62 | - | - | - | - | - | - | - | - |

| | Analyses. | Moisture. | Ash. | NITROGEN. | | | POTASH. | | | TOTAL PHOSPHORIC ACID. | | | Soluble Phosphoric Acid. | Reverted Phosphoric Acid. | Insoluble Phosphoric Acid. | Soda. | Lime. | Magnesia. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | | | | | | | | | | | |
| *III. Refuse Substances*—Continued. | | | | | | | | | | | | | | | | | | | | | | | |
| Horn and hoof waste, | 3 | 10.17 | 7.63 | 15.49 | 11.84 | 13.25 | - | - | - | 2.30 | 1.36 | 1.83 | - | - | - | - | - | - | - | - | - | - | .24 |
| Raw wool, | 1 | 6.95 | 7.54 | - | - | 12.88 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3.63 |
| Wool waste, | 8 | 14.26 | 24.10 | 10.20 | 1.05 | 5.27 | 3.08 | .06 | 1.21 | .67 | .05 | .35 | - | - | - | - | .11 | .06 | .80 | - | - | - | 8.20 |
| Wool washings (water), | 1 | - | - | - | - | - | - | - | 3.92 | - | - | - | - | - | - | .49 | .28 | - | - | - | - | - | - |
| Wool washings (acid), | 1 | - | - | - | - | - | - | - | 4.20 | - | - | - | - | - | - | .40 | .61 | .20 | - | - | - | - | - |
| Wool washings (alkaline), | 1 | 92.03 | 3.28 | - | - | .09 | - | - | 1.09 | - | - | - | - | - | - | .92 | .04 | - | - | - | - | - | .22 |
| Meat mass, | 5 | 12.09 | 13.60 | 11.50 | 9.69 | 10.44 | - | - | - | 3.58 | .56 | 2.07 | - | - | - | - | - | - | - | - | - | - | .58 |
| Bone soup, | 1 | 82.92 | 7.07 | - | - | 1.14 | - | - | - | - | - | 1.26 | - | - | - | - | - | - | - | - | - | - | - |
| Dried soup from meat and bone, | 1 | 14.80 | 8.40 | - | - | 9.97 | - | - | - | - | - | .53 | - | - | - | - | - | - | - | - | - | - | .64 |
| Dried soup from rendering cattle feet, | 1 | 10.80 | 7.50 | - | - | 14.47 | - | - | - | - | - | .46 | - | - | - | - | - | - | - | - | - | - | .26 |
| Dried soup from horse rendering, | 1 | 92.14 | - | - | - | 1.12 | - | - | - | - | - | .14 | - | - | - | - | - | - | - | - | - | - | - |
| Soap-grease refuse, | 2 | 29.25 | 51.39 | 4.20 | 2.21 | 3.21 | - | - | - | 15.37 | 11.04 | 13.21 | - | - | - | - | - | - | - | - | - | - | 1.29 |
| Bones, | 148 | 6.94 | 56.03 | 4.70 | 1.57 | 3.96 | - | - | - | 32.52 | 15.16 | 22.24 | .38 | 8.24 | 13.62 | - | - | - | - | - | - | - | 1.09 |
| Meat and bone, | 1 | 5.70 | - | - | - | 4.01 | - | - | - | - | - | 21.88 | .26 | 8.32 | 13.30 | - | - | - | - | - | - | - | - |
| Fish with less than twenty per cent. water, | 62 | 12.56 | 21.50 | 11.40 | 6.81 | 7.32 | - | - | - | 11.26 | 5.50 | 8.25 | .55 | 2.64 | 5.06 | - | - | - | - | - | - | - | 2.01 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fish with between twenty and forty per cent. water, | 10 | 30.19 | 20.59 | 7.41 | 4.22 | 5.97 | - | - | - | 8.32 | 4.68 | 7.09 | .74 | 2.69 | 3.64 | - | - | - | - | - | - | - | 1.68 |
| Fish with more than forty per cent. water, | 10 | 45.46 | 15.50 | 7.60 | 2.43 | 4.97 | - | - | - | 8.56 | 2.94 | 5.08 | 1.17 | 1.33 | 2.58 | - | - | - | - | - | - | - | 1.35 |
| Whale meat, raw, | 1 | 44.50 | 1.04 | - | - | 4.86 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lobster shells, | 1 | 7.27 | - | - | - | 4.50 | - | - | - | - | - | 3.52 | - | - | - | - | 22.24 | 1.30 | - | - | - | - | .27 |
| Castor-bean pomace, | 6 | 9.68 | 5.70 | 5.72 | 5.22 | 5.51 | 3.40 | .64 | 1.57 | 2.26 | 1.57 | 2.18 | - | - | - | - | .87 | .29 | - | - | - | - | 1.75 |
| Cotton-seed meal, | 24 | 6.47 | 5.78 | 7.26 | 4.02 | 6.63 | 2.09 | .48 | 1.69 | 3.36 | .73 | 1.54 | - | - | - | - | - | - | - | - | - | - | .33 |
| Rotten brewers' grain, | 1 | 78.77 | - | - | - | .72 | - | - | .04 | - | - | .43 | - | - | - | - | .26 | .15 | - | - | - | - | .59 |
| Mill sweepings, | 1 | 9.49 | - | - | - | 3.76 | - | - | .66 | - | - | 1.18 | - | - | - | - | - | - | - | - | - | - | 5.01 |
| Tobacco leaf, | 1 | 13.05 | 21.01 | - | - | 2.75 | - | - | 7.24 | - | - | .43 | - | - | - | - | 4.17 | 2.17 | .32 | - | - | - | 4.17 |
| Tobacco stems, | 6 | 10.61 | 14.07 | 2.91 | .90 | 2.29 | 8.82 | 3.76 | 6.44 | 2.09 | .44 | .60 | - | - | - | .34 | 3.89 | 1.23 | - | - | - | - | .82 |
| Cotton waste, wet, | 1 | 34.69 | - | - | - | 1.30 | - | - | .80 | - | - | 1.54 | - | - | - | - | 2.45 | 1.13 | - | - | - | - | 41.33 |
| Cotton waste, dry, | 3 | 6.44 | 60.60 | 2.09 | .96 | 1.50 | 1.62 | .66 | 1.10 | .84 | .26 | .52 | - | - | - | - | - | - | - | - | - | - | 45.00 |
| Cotton dust, | 1 | 34.46 | 50.93 | - | - | .50 | - | - | .19 | - | - | .21 | - | - | - | - | .90 | .90 | - | - | - | - | 47.46 |
| Glucose refuse, | 1 | 8.10 | - | - | - | 2.62 | - | - | .15 | - | - | .29 | - | - | - | - | .18 | .02 | - | - | - | - | .07 |
| Waste from lactate factory, | 1 | 34.11 | - | - | - | .68 | - | - | - | - | - | .67 | - | - | - | - | 22.59 | - | - | - | - | - | 6.92 |
| Hop refuse, | 1 | 8.98 | - | - | - | .98 | - | - | .11 | - | - | .20 | - | - | - | - | .27 | .10 | - | - | - | - | .63 |
| Banana skins, | 1 | 13.99 | - | - | - | .24 | - | - | 5.46 | - | - | 1.80 | - | - | - | - | - | - | - | - | - | - | - |
| Sumac waste, | 1 | 63.06 | 6.80 | - | - | 1.19 | - | - | 3.25 | - | - | - | - | - | - | - | 1.14 | 3.25 | - | - | - | - | 2.25 |
| Eel-grass, | 2 | 35.39 | 15.60 | .96 | .70 | .83 | 1.61 | .21 | .91 | .41 | .22 | .32 | - | - | - | 1.63 | 2.13 | .11 | - | - | - | - | 1.06 |
| Pine-barren grass, | 1 | 8.48 | 2.40 | - | - | .16 | - | - | .07 | - | - | .18 | - | - | - | - | - | - | - | - | - | - | 1.67 |
| Pine needles, | 1 | 9.48 | 3.42 | - | - | .46 | - | - | .03 | - | - | .12 | - | - | - | - | - | - | - | - | - | - | 1.22 |

|  | Analyses. | Moisture. | Ash. | NITROGEN. |  |  | POTASH. |  |  | TOTAL PHOSPHORIC ACID. |  |  | Soluble Phosphoric Acid. | Reverted Phosphoric Acid. | Insoluble Phosphoric Acid. | Soda. | Lime. | Magnesia. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. |  |  |  |  |  |  |  |  |  |  |  |
| *III. Refuse Substances*—Concluded. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Rockweed, green, | 1 | 68.50 | 23.70 | - | - | .62 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Rockweed, dry, | 1 | 10.68 | 35.75 | - | - | 1.45 | - | - | 4.89 | - | - | 2.75 | - | - | - | 7.90 | 7.66 | .21 | - | - | - | - | 10.40 |
| Jute waste, | 1 | 13.10 | - | - | - | 1.50 | - | - | .08 | - | - | .72 | - | - | - | - | - | - | - | - | - | - | - |
| Starch waste from rubber factory, | 1 | 10.01 | .23 | - | - | .02 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Sludge from sewage precipitating tanks, | 1 | 88.49 | 9.50 | - | - | .05 | - | - | .05 | - | - | .10 | - | - | - | - | 1.58 | .39 | 6.22 | - | - | - | .93 |
| Sludge, | 1 | 6.28 | - | - | - | .68 | - | - | - | - | - | 1.36 | - | - | - | - | 8.66 | - | 17.68 | - | - | - | 38.03 |
| Blue-green algæ (*Lyngbia majuscula*), dry, | 1 | 16.26 | - | - | - | 4.25 | - | - | .79 | - | - | .19 | - | - | - | 3.53 | 2.06 | 1.18 | - | - | - | - | 5.53 |
| Mussel mud, wet, | 1 | 60.01 | 27.29 | - | - | .21 | - | - | 6.17 | - | - | .10 | - | - | - | .70 | .93 | .14 | 3.48 | - | - | - | - |
| Mussel mud, dry, | 1 | 2.24 | 72.02 | - | - | .72 | - | - | - | - | - | .35 | - | - | - | - | 23.39 | - | 8.26 | - | - | - | 37.60 |
| Salt mud, | 2 | 53.37 | 41.19 | .40 | .39 | .40 | .33 | .32 | .33 | - | - | - | - | - | - | .94 | .91 | .37 | 4.13 | - | - | - | 34.88 |
| Fresh-water mud, | 1 | 40.37 | - | - | - | 1.37 | - | - | .22 | - | - | .26 | - | - | - | - | 1.27 | .29 | 1.80 | - | - | - | 18.26 |
| Muck, | 16 | 60.26 | 13.75 | 2.54 | .26 | .97 | - | - | - | .17 | .08 | .13 | - | - | - | - | - | - | - | - | - | - | 11.35 |
| Peat, | 10 | 61.50 | 8.20 | 1.40 | .41 | .85 | - | - | .18 | - | - | .08 | - | - | - | - | .52 | .72 | 2.14 | - | - | - | 2.20 |
| Peat, | 1 | 10.73 | 17.26 | - | - | 1.73 | - | - | .06 | - | - | .03 | - | - | - | - | - | - | - | - | - | - | 10.14 |
| Turf, | 2 | 19.29 | 6.36 | 1.97 | 1.91 | 1.94 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soot, | 3 | 1.88 | 77.10 | .21 | .09 | .15 | 1.83 | .21 | .76 | 1.54 | .19 | .87 | - | - | - | - | 3.11 | - | 7.19 | - | - | - | 67.25 |
| Boiler soot, | 1 | 18.80 | - | - | - | - | - | - | .26 | - | - | .70 | - | - | - | - | 58.28 | 1.46 | 1.46 | - | 32.95 | - | 3.09 |
| *IV. Animal Excrement, etc.* | | | | | | | | | | | | | | | | | | | | | | | |
| Barn-yard manure, | 56 | 66.49 | - | 1.366 | .21 | .54 | 1.40 | .13 | .53 | .75 | .10 | .41 | - | - | - | - | .30 | .19 | - | - | - | - | 8.48 |
| Horse manure, | 1 | 11.24 | - | - | - | .74 | - | - | 2.82 | - | - | 1.46 | - | - | - | - | - | - | - | - | - | - | 12.60 |
| Sheep manure, | 1 | 64.88 | - | - | - | .686 | - | - | .525 | - | - | .425 | - | - | - | - | - | - | - | - | - | - | .404 |
| Drainage from a manure heap, | 1 | 93.20 | 3.66 | - | - | .98 | - | - | .88 | - | - | .24 | - | - | - | - | - | - | - | - | - | - | - |
| Poudrette, dry, | 1 | 5.25 | 35.45 | - | - | 3.58 | - | - | .49 | - | - | 5.74 | - | - | - | - | - | - | - | - | - | - | 4.65 |
| Hen manure, fre , | 2 | 52.35 | 24.75 | 1.20 | .79 | .99 | .32 | .18 | .25 | 1.00 | .47 | .74 | - | - | - | - | 1.19 | .89 | - | 1.24 | - | - | 23.50 |
| Hen manure, dry, | 1 | 8.35 | - | - | - | 2.13 | - | - | 9.94 | - | - | 2.02 | - | - | - | - | 2.22 | .62 | - | - | - | - | 34.64 |

# V. COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS, SUGAR-PRODUCING PLANTS, DAIRY PRODUCTS, ETC.,

MADE AT

AMHERST, MASS.

## 1868-1894.

PREPARED BY C. S. CROCKER.

*A.* ANALYSES OF FODDER ARTICLES.
*B.* ANALYSES OF FODDER ARTICLES WITH REFERENCE TO FERTILIZING INGREDIENTS.
*C.* ANALYSES OF FRUIT.
*D.* ANALYSES OF SUGAR-PRODUCING PLANTS.
*E.* DAIRY PRODUCTS.
*F.* INSECTICIDES.

## A. *Analyses of Fodder Articles.*

| NAME. | Analyses. | DRY MATTER. | | | ONE HUNDRED PARTS OF DRY MATTER CONTAIN — | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PROTEIN. | | | FAT. | | | NITROGEN-FREE EXTRACT. | | | FIBRE. | | | Ash. |
| | | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | |
| *I. Green Fodders.* | | | | | | | | | | | | | | | | | |
| Fodder corn, | 31 | 31.47 | 10.33 | **20.29** | 17.19 | 6.05 | **9.86** | 6.10 | 1.42 | **2.44** | 63.13 | 42.02 | **56.51** | 31.53 | 18.27 | **25.29** | 5.90 |
| Fodder corn ensilage, | 38 | 37.43 | 13.12 | **21.70** | 16.72 | 5.98 | **8.66** | 6.49 | 1.82 | **3.80** | 65.69 | 42.99 | **54.28** | 38.92 | 17.67 | **27.73** | 5.53 |
| Corn and soja-bean ensilage, | 3 | 28.97 | 19.67 | **23.55** | 15.27 | 7.91 | **10.53** | 5.35 | 3.02 | **4.04** | 52.24 | 40.50 | **43.47** | 37.84 | 26.62 | **31.15** | 10.81 |
| Oat and pea ensilage, | 1 | – | – | **61.98** | – | – | **13.72** | – | – | **3.94** | – | – | **41.81** | – | – | **31.34** | 9.19 |
| Ensilage of *Panicum miliaceum*, | 1 | – | – | **21.99** | – | – | **7.46** | – | – | **3.34** | – | – | **49.08** | – | – | **31.80** | 8.32 |
| Ensilage of *Panicum crus-galli*, | 1 | – | – | **23.25** | – | – | **7.89** | – | – | **2.74** | – | – | **43.87** | – | – | **36.93** | 8.57 |
| Sorghum, | 6 | 23.18 | 12.38 | **17.41** | 11.84 | 7.46 | **8.74** | 2.00 | 1.21 | **1.55** | 64.93 | 47.65 | **56.15** | 29.27 | 22.00 | **26.73** | 6.83 |
| Common millet, | 9 | 42.29 | 21.32 | **35.42** | 12.16 | 5.43 | **7.50** | 3.99 | 2.09 | **2.74** | 58.61 | 46.39 | **53.93** | 33.98 | 24.88 | **30.99** | 4.84 |
| Japanese millet (white head), | 3 | 26.24 | 20.95 | **24.76** | 10.98 | 7.26 | **8.72** | 2.64 | 1.94 | **2.33** | 50.87 | 46.71 | **49.60** | 38.90 | 30.12 | **34.47** | 4.88 |
| Japanese millet (red head), | 6 | 33.83 | 22.66 | **27.33** | 7.99 | 4.92 | **6.90** | 2.45 | 1.58 | **2.01** | 60.83 | 50.11 | **52.91** | 35.29 | 25.21 | **32.10** | 6.08 |
| *Panicum miliaceum*, | 1 | – | – | **30.63** | – | – | **5.96** | – | – | **3.84** | – | – | **58.82** | – | – | **26.85** | 5.53 |
| *Panicum crus-galli*, | 2 | 29.28 | 24.89 | **27.08** | 11.45 | 7.98 | **9.71** | 2.79 | 2.20 | **2.49** | 57.88 | 46.50 | **52.20** | 29.51 | 26.31 | **27.91** | 7.69 |
| White kibi, | 2 | 24.26 | 22.85 | **23.56** | 15.14 | 10.79 | **12.97** | 1.61 | 1.50 | **1.56** | 53.66 | 52.30 | **47.29** | 35.29 | 25.21 | **32.10** | 6.08 |
| Mochi millet, | 3 | 42.29 | 30.07 | **37.42** | 11.90 | 6.11 | **9.94** | 1.94 | 1.74 | **1.81** | 67.08 | 49.06 | **55.69** | 29.80 | 20.01 | **25.56** | 7.00 |
| Green oats, | 6 | 55.69 | 15.51 | **25.97** | 20.47 | 7.05 | **13.91** | 3.95 | 2.02 | **2.89** | 50.69 | 40.42 | **44.91** | 33.12 | 25.20 | **30.04** | 8.25 |
| Green rye, | 2 | 37.89 | 98.05 | **27.97** | 9.64 | 5.38 | **7.51** | 2.46 | 1.86 | **2.16** | 65.37 | 40.20 | **52.79** | 42.17 | 21.52 | **31.84** | 5.70 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green barley, | 1 | - | - | 20.89 | - | - | 13.16 | - | - | 2.91 | - | - | 37.48 | - | - | 37.72 | 8.73 |
| Timothy (*Phleum pratense*), | 2 | 35.00 | 34.26 | 34.63 | 8.83 | 8.20 | 8.52 | 2.07 | 1.95 | 2.01 | 51.33 | 51.23 | 51.27 | 33.23 | 32.50 | 32.87 | 5.33 |
| Hungarian grass (*Setaria Italica* Beauv.), | 2 | 25.93 | 25.69 | 25.81 | 9.39 | 9.38 | 9.38 | 2.43 | 1.01 | 1.72 | 57.80 | 48.01 | 52.92 | 31.23 | 24.66 | 27.94 | 8.04 |
| Vetch and oats (one part vetch and four parts oats), | 1 | - | - | 20.84 | - | - | 13.27 | - | - | 3.90 | - | - | 43.69 | - | - | 30.34 | 8.80 |
| Vetch and oats (one part vetch and nine parts oats), | 3 | 24.04 | 13.89 | 18.97 | 10.76 | 8.83 | 10.06 | 2.74 | 2.29 | 2.53 | 49.85 | 40.10 | 44.75 | 35.81 | 30.77 | 33.59 | 9.07 |
| Vetch and oats (equal parts of each), | 1 | - | - | 17.98 | - | - | 16.77 | - | - | 2.79 | - | - | 41.33 | - | - | 29.80 | 9.31 |
| Barley and peas, | 1 | - | - | 16.09 | - | - | 13.40 | - | - | 3.00 | - | - | 41.79 | - | - | 33.49 | 8.32 |
| Oats and peas, | 2 | 18.41 | 13.68 | 16.04 | 16.01 | 14.17 | 15.09 | 3.40 | 2.29 | 2.84 | 48.14 | 40.56 | 44.36 | 32.20 | 26.66 | 29.43 | 8.28 |
| Horse bean (*Vicia faba*, L.), | 1 | - | - | 15.17 | - | - | 16.68 | - | - | 2.31 | - | - | 47.09 | - | - | 28.17 | 5.75 |
| Flat pea (*Lathyrus sylvestris*), | 1 | - | - | 21.38 | - | - | 30.65 | - | - | 5.00 | - | - | 35.06 | - | - | 20.38 | 8.91 |
| Soja bean (*Soja hispida*), | 14 | 36.36 | 18.54 | 24.48 | 22.19 | 13.71 | 17.26 | 8.98 | 2.71 | 4.57 | 47.89 | 34.24 | 41.73 | 31.89 | 21.67 | 26.47 | 9.97 |
| Soja bean (early white), | 1 | - | - | 33.44 | - | - | 17.63 | - | - | 2.77 | - | - | 37.23 | - | - | 27.12 | 15.25 |
| Soja bean (early green), | 1 | - | - | 30.16 | - | - | 19.35 | - | - | 3.87 | - | - | 40.30 | - | - | 23.51 | 12.97 |
| Soja bean (medium black), | 1 | - | - | 23.13 | - | - | 21.67 | - | - | 6.76 | - | - | 37.18 | - | - | 21.73 | 12.66 |
| Soja bean (late), | 1 | - | - | 20.22 | - | - | 18.56 | - | - | 2.25 | - | - | 34.24 | - | - | 23.62 | 21.33 |
| Kidney vetch (*Anthyllis vulneraria*), | 1 | - | - | 19.15 | - | - | 18.43 | - | - | 3.51 | - | - | 49.84 | - | - | 14.94 | 13.28 |
| Cow-pea vines (*Dolichos sinensis*), | 3 | 21.19 | 18.15 | 19.63 | 17.93 | 11.24 | 14.59 | 2.99 | 1.81 | 2.48 | 60.62 | 46.13 | 54.42 | 25.88 | 21.87 | 23.59 | 6.92 |
| Serradella (*Ornithopus sativus* Brot.), | 3 | 19.42 | 15.40 | 17.59 | 17.75 | 12.17 | 15.01 | 2.65 | 2.09 | 2.41 | 46.41 | 35.45 | 41.51 | 38.76 | 26.21 | 30.08 | 10.99 |
| Prickley comfrey (*Symphytum officinale*), | 1 | - | - | 13.21 | - | - | 17.49 | - | - | 2.06 | - | - | 48.30 | - | - | 11.03 | 21.12 |
| White lupine (*Lupinus albus*), | 1 | - | - | 14.65 | - | - | 18.71 | - | - | 2.41 | - | - | 42.67 | - | - | 31.18 | 5.03 |
| Yellow lupine (*Lupinus lutens*), | 1 | - | - | 13.95 | - | - | 17.84 | - | - | 1.87 | - | - | 42.05 | - | - | 27.10 | 11.14 |
| Spanish moss (*Tillandsia usneoides*), | 1 | - | - | 39.20 | - | - | 4.45 | - | - | 2.54 | - | - | 57.73 | - | - | 32.61 | 2.67 |

## *A. Analyses of Fodder Articles* — Continued.

| NAME. | Analyses. | DRY MATTER. | | | ONE HUNDRED PARTS OF DRY MATTER CONTAIN — | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PROTEIN. | | | FAT. | | | NITROGEN-FREE EXTRACT. | | | FIBRE. | | | Ash. |
| | | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | |
| *II. Hay and Dry Coarse Fodders.* | | | | | | | | | | | | | | | | | |
| English hay (mixed hay), | 56 | 91.94 | 66.59 | 85.53 | 14.19 | 6.19 | 9.46 | 4.10 | 1.56 | 2.85 | 54.72 | 43.63 | 50.29 | 35.55 | 26.41 | 31.05 | 6.35 |
| Rowen of mixed hays, | 14 | 91.76 | 75.55 | 82.83 | 14.70 | 11.63 | 12.60 | 5.03 | 2.60 | 3.64 | 53.52 | 41.92 | 49.76 | 31.50 | 24.25 | 26.82 | 7.18 |
| Timothy hay, | 6 | 92.76 | 81.26 | 89.39 | 9.37 | 7.24 | 8.66 | 2.65 | 1.95 | 2.22 | 54.43 | 50.01 | 51.34 | 36.59 | 29.21 | 32.90 | 4.88 |
| Red top hay (*Agrostis vulgaris* With.), | 4 | 93.19 | 91.76 | 92.30 | 8.40 | 6.41 | 7.88 | 1.69 | 1.50 | 1.60 | 54.74 | 50.32 | 52.63 | 34.11 | 31.12 | 32.92 | 4.97 |
| Kentucky blue-grass (*Poa pratensis* L.), | 2 | 96.10 | 93.22 | 94.66 | 8.78 | 8.65 | 8.72 | 2.08 | 2.03 | 2.06 | 49.61 | 44.11 | 46.29 | 36.84 | 32.21 | 34.58 | 8.35 |
| Orchard grass (*Dactylis glomerata* L.), | 4 | 91.62 | 90.86 | 91.17 | 11.29 | 7.57 | 8.99 | 3.56 | 2.40 | 2.91 | 47.34 | 43.50 | 46.16 | 35.79 | 34.12 | 34.89 | 7.05 |
| Meadow fescue (*Festuca pratensis* Huds ), | 5 | 94.70 | 87.84 | 91.09 | 7.85 | 5.89 | 6.76 | 2.17 | 1.65 | 1.87 | 49.18 | 42.03 | 46.31 | 39.90 | 34.61 | 36.93 | 8.13 |
| Perennial rye-grass (*Lolium perenne* L.), | 4 | 93.64 | 90.50 | 92.60 | 16.56 | 6.59 | 11.71 | 3.15 | 1.59 | 2.37 | 55.77 | 38.82 | 48.14 | 30.86 | 26.79 | 29.64 | 8.14 |
| Italian rye grass (*Lolium Italicum* A. Br.), | 4 | 92.62 | 90.70 | 91.54 | 9.75 | 6.20 | 8.15 | 2.07 | 1.39 | 1.85 | 52.80 | 43.09 | 49.14 | 36.90 | 31.27 | 33.34 | 7.52 |
| Hungarian grass, | 1 | - | - | 92.55 | - | - | 9.45 | - | - | 2.22 | - | - | 50.64 | - | - | 31.96 | 5.73 |
| Barn-yard grass (*Panicum crus-galli* L.), | 1 | - | - | 93.35 | - | - | 15.27 | - | - | 1.95 | - | - | 30.24 | - | - | 33.72 | 10.02 |
| Hay of black grass, | 1 | - | - | 91.25 | - | - | 6.72 | - | - | 3.37 | - | - | 49.47 | - | - | 31.41 | 9.03 |
| Low meadow hay, | 1 | - | - | 91.99 | - | - | 9.51 | - | - | 1.88 | - | - | 46.27 | - | - | 35.59 | 6.75 |
| Salt hay, | 2 | 91.92 | 90.34 | 91.13 | 4.35 | 3.77 | 4.06 | 3.24 | 2.65 | 2.95 | 60.15 | 60.14 | 60.14 | 27.84 | 27.82 | 27.83 | 5.02 |
| Millet, | 6 | 93.85 | 90.25 | 92.54 | 8.88 | 7.09 | 7.81 | 3.63 | .89 | 2.05 | 55.80 | 49.62 | 51.74 | 35.91 | 29.80 | 33.32 | 5.08 |
| Oats in bloom, | 1 | - | - | 93.57 | - | - | 6.58 | - | - | 2.92 | - | - | 50.03 | - | - | 34.06 | 6.41 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oats in milk, | 1 | - | - | 90.45 | - | - | 10.89 | - | - | 2.69 | - | - | 46.02 | - | - | 34.32 | 6.08 |
| Oats, ripe, | 1 | - | - | 91.30 | - | - | 6.05 | - | - | 2.61 | - | - | 48.92 | - | - | 36.31 | 6.11 |
| Winter rye in bloom, | 1 | - | - | 91.45 | - | - | 10.66 | - | - | 2.57 | - | - | 47.40 | - | - | 32.97 | 6.40 |
| Barley in milk, | 1 | - | - | 89.75 | - | - | 10.26 | - | - | 2.76 | - | - | 52.91 | - | - | 29.12 | 4.95 |
| Common buckwheat, | 1 | - | - | 91.50 | - | - | 17.90 | - | - | 3.04 | - | - | 45.08 | - | - | 19.35 | 14.63 |
| Silver hull buckwheat, | 1 | - | - | 91.09 | - | - | 12.22 | - | - | 2.55 | - | - | 47.99 | - | - | 27.07 | 10.17 |
| Japanese buckwheat, | 1 | - | - | 94.29 | - | - | 10.80 | - | - | 2.22 | - | - | 38.60 | - | - | 36.02 | 12.36 |
| Dry fodder corn, | 4 | 93.35 | 90.58 | 92.11 | 9.31 | 6.17 | 7.74 | 2.76 | 1.11 | 1.84 | 58.89 | 53.86 | 55.97 | 33.75 | 23.03 | 23.31 | 5.14 |
| Corn stover, | 27 | 94.44 | 75.00 | 88.15 | 12.15 | 5.46 | 7.28 | 2.63 | 1.08 | 1.38 | 63.05 | 44.65 | 50.60 | 38.83 | 20.93 | 34.95 | 5.79 |
| Teosinte (*Euchlæna luxurians* Dur. and Asch.), | 1 | - | - | 93.94 | - | - | 9.71 | - | - | 1.28 | - | - | 53.18 | - | - | 28.88 | 6.95 |
| Mammoth red clover (*Trifolium medium* L.), | 3 | 92.66 | 82.47 | 88.59 | 18.50 | 14.06 | 15.75 | 2.25 | 1.86 | 2.13 | 48.98 | 46.51 | 44.77 | 33.72 | 20.16 | 27.51 | 9.84 |
| Alsike clover (*Trifolium hybridum* L.), | 6 | 93.92 | 86.48 | 90.07 | 17.55 | 14.77 | 16.63 | 3.26 | 1.88 | 2.58 | 46.64 | 38.03 | 42.72 | 32.34 | 21.44 | 26.17 | 11.90 |
| Medium red clover (*Trifolium pratense* L.), | 2 | 94.90 | 93.98 | 94.44 | 15.01 | 14.63 | 14.82 | 2.62 | 2.36 | 2.49 | 43.88 | 42.81 | 43.34 | 30.76 | 29.97 | 30.37 | 8.98 |
| Lucerne (alfalfa) (*Medicago sativa* Desr.), | 5 | 95.40 | 84.00 | 91.40 | 16.34 | 11.12 | 14.22 | 2.50 | 1.04 | 1.65 | 51.62 | 40.25 | 46.20 | 34.39 | 25.42 | 29.72 | 8.11 |
| Sand lucerne (*Medicago media* Pers.), | 1 | - | - | 91.20 | - | - | 16.26 | - | - | 2.59 | - | - | 50.31 | - | - | 21.27 | 9.57 |
| Bokhara clover (*Melilotus alba* Desr.) | 2 | 93.64 | 91.50 | 92.57 | 14.93 | 11.81 | 13.37 | 4.79 | 1.85 | 3.32 | 51.36 | 38.83 | 45.08 | 33.05 | 28.08 | 30.57 | 7.66 |
| Blue melilot (*Melilotus cærulea* Desr.), | 1 | - | - | 91.78 | - | - | 13.81 | - | - | 1.67 | - | - | 42.48 | - | - | 27.17 | 14.87 |
| Sanfoin (*Onobrychis sativa*), | 1 | - | - | 87.83 | - | - | 17.70 | - | - | 4.49 | - | - | 42.32 | - | - | 26.95 | 8.54 |
| Sulla (*Hedysarum coronarium*), | 2 | 91.68 | 89.59 | 90.61 | 17.03 | 16.90 | 16.97 | 3.16 | 2.39 | 2.78 | 58.66 | 41.89 | 50.26 | 28.95 | 12.38 | 20.67 | 9.32 |
| Hairy lotus (*Lotus villosus* Thuill.), | 2 | 89.32 | 87.64 | 88.48 | 16.12 | 13.49 | 14.81 | 3.00 | 2.69 | 2.85 | 57.82 | 50.80 | 54.29 | 24.48 | 15.07 | 19.78 | 8.27 |
| Summer rape (*Brassica napus*), | 1 | - | - | 88.87 | - | - | 14.43 | - | - | 3.79 | - | - | 45.38 | - | - | 18.15 | 18.25 |
| Soja bean, | 4 | 93.88 | 79.91 | 87.78 | 19.06 | 14.89 | 16.23 | 8.33 | 2.55 | 4.72 | 51.28 | 41.09 | 46.70 | 27.73 | 20.76 | 24.02 | 8.33 |

## *A. Analyses of Fodder Articles* — Continued.

| NAME. | Analyses. | DRY MATTER. | | | ONE HUNDRED PARTS OF DRY MATTER CONTAIN — | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PROTEIN. | | | FAT. | | | NITROGEN-FREE EXTRACT. | | | FIBRE. | | | Ash. |
| | | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | |
| *II. Hay and Dry Coarse Fodders* — Concluded. | | | | | | | | | | | | | | | | | |
| Cow-pea, | 3 | 90.70 | 90.25 | 90.43 | 17.17 | 16.95 | 17.05 | 4.49 | 3.81 | 4.06 | 51.41 | 46.06 | 47.93 | 23.58 | 19.06 | 21.67 | 9.29 |
| Small pea (*Lathyrus sativus*), | 1 | – | – | 94.20 | – | – | 16.57 | – | – | 1.49 | – | – | 42.76 | – | – | 32.88 | 6.30 |
| Flat pea (*Lathyrus sylvestris*), | 1 | – | – | 91.10 | – | – | 24.04 | – | – | 1.78 | – | – | 33.03 | – | – | 31.76 | 9.39 |
| Serradella, | 3 | 92.80 | 87.23 | 90.44 | 17.97 | 15.26 | 17.03 | 2.91 | 2.37 | 2.55 | 50.22 | 44.49 | 48.18 | 25.92 | 24.37 | 25.15 | 7.09 |
| Hairy vetch (*Vicia villosa* Roth.), | 1 | – | – | 92.56 | – | – | 19.58 | – | – | 1.22 | – | – | 38.95 | – | – | 31.88 | 8.37 |
| Common vetch (*Vicia sativa* L.), | 2 | 91.65 | 90.55 | 91.10 | 15.76 | 14.42 | 15.09 | 2.69 | 2.30 | 2.50 | 44.34 | 43.29 | 43.80 | 30.68 | 30.05 | 30.37 | 8.24 |
| Scotch tares, | 1 | – | – | 84.20 | – | – | 22.00 | – | – | 1.89 | – | – | 31.46 | – | – | 30.89 | 13.76 |
| Vetch and oats, | 3 | 94.22 | 83.33 | 88.35 | 13.51 | 7.70 | 9.64 | 3.45 | 2.53 | 3.11 | 49.95 | 41.51 | 46.83 | 36.22 | 30.15 | 32.70 | 7.72 |
| Horse-bean straw, | 1 | – | – | 90.85 | – | – | 9.69 | – | – | 1.51 | – | – | 37.77 | – | – | 41.44 | 9.59 |
| Soja-bean straw, | 3 | 92.37 | 86.03 | 88.57 | 5.73 | 5.34 | 5.48 | 3.49 | 1.17 | 2.15 | 43.72 | 41.02 | 42.81 | 46.51 | 36.80 | 42.38 | 7.18 |
| White daisy (*Chrysanthemum leucanthemum* L.), | 1 | – | – | 90.35 | – | – | 7.68 | – | – | 2.32 | – | – | 46.86 | – | – | 36.09 | 7.05 |
| Dry carrot tops, | 1 | – | – | 90.24 | – | – | 20.12 | – | – | 2.01 | – | – | 50.39 | – | – | 13.61 | 13.87 |
| Wheat straw, | 1 | – | – | 93.80 | – | – | 7.20 | – | – | 1.63 | – | – | 50.46 | – | – | 35.91 | 4.80 |
| Barley straw, | 1 | – | – | 88.56 | – | – | 9.24 | – | – | 3.38 | – | – | 48.23 | – | – | 33.85 | 5.30 |
| Japanese millet (white head), | 1 | – | – | 91.48 | – | – | 7.67 | – | – | 2.41 | – | – | 49.87 | – | – | 34.99 | 5.06 |
| Japanese millet (red head), | 1 | – | – | 91.13 | – | – | 5.76 | – | – | 1.70 | – | – | 49.66 | – | – | 39.52 | 3.36 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Millet straw, | 1 | - | - | 86.55 | - | - | 4.95 | - | - | 1.43 | - | - | 44.96 | - | - | 41.82 | 6.84 |
| Straw (*Panicum crus-galli*), | 1 | - | - | 87.35 | - | - | 6.10 | - | - | 2.44 | - | - | 50.20 | - | - | 35.90 | 5.36 |
| Straw (*P. miliaceum*), | 1 | - | - | 87.83 | - | - | 3.94 | - | - | 3.01 | - | - | 44.72 | - | - | 42.16 | 6.17 |
| Straw (*P. Italicum*), | 1 | - | - | 80.28 | - | - | 4.17 | - | - | 1.59 | - | - | 46.39 | - | - | 41.54 | 6.31 |
| *III. Roots, Bulbs, Tubers, etc.* | | | | | | | | | | | | | | | | | |
| Beets, red, | 7 | 14.51 | 9.75 | 12.17 | 15.40 | 7.82 | 12.29 | 1.76 | .59 | .94 | 79.33 | 66.87 | 72.19 | 7.56 | 4.29 | 6.00 | 8.58 |
| Beets, sugar, | 12 | 19.53 | 9.87 | 14.60 | 17.44 | 7.32 | 11.18 | .83 | .58 | .67 | 81.50 | 61.93 | 75.62 | 9.69 | 4.82 | 6.55 | 5.98 |
| Beets, yellow fodder, | 4 | 15.01 | 9.40 | 11.46 | 13.96 | 9.29 | 11.69 | 2.02 | .84 | 1.39 | 75.22 | 61.90 | 69.33 | 9.66 | 7.26 | 8.14 | 9.45 |
| Mangolds, | 4 | 13.08 | 11.49 | 12.06 | 12.84 | 7.04 | 9.54 | 1.14 | .73 | .97 | 73.38 | 70.32 | 71.03 | 9.98 | 7.08 | 8.45 | 10.01 |
| Ruta-bagas, | 3 | 12.77 | 8.25 | 10.88 | 11.46 | 10.34 | 11.01 | 2.32 | 1.23 | 1.53 | 68.58 | 62.27 | 65.88 | 13.12 | 11.03 | 11.83 | 9.75 |
| Turnips, | 4 | 12.80 | 8.22 | 10.11 | 11.12 | 9.67 | 10.37 | 2.05 | 1.42 | 1.68 | 70.62 | 65.91 | 57.37 | 13.34 | 10.12 | 11.75 | 8.83 |
| Carrots, | 4 | 12.52 | 9.95 | 11.15 | 9.75 | 7.98 | 9.13 | 3.94 | 1.41 | 2.11 | 73.96 | 67.24 | 70.12 | 10.76 | 7.55 | 9.09 | 8.55 |
| Parsnips, | 1 | - | - | 19.66 | - | - | 6.88 | - | - | 3.37 | - | - | 74.65 | - | - | 7.67 | 7.43 |
| Potatoes, | 10 | 21.95 | 13.91 | 18.78 | 13.56 | 6.24 | 10.01 | .83 | .17 | .48 | 87.56 | 78.80 | 81.50 | 3.55 | 1.91 | 2.75 | 5.26 |
| Artichokes, | 1 | - | - | 22.51 | - | - | 12.82 | - | - | .95 | - | - | 77.26 | - | - | 4.18 | 4.79 |
| Japanese radish (*merinia*), | 1 | - | - | 6.74 | - | - | 7.47 | - | - | 1.05 | - | - | 70.89 | - | - | 10.27 | 10.32 |
| Japanese radish (*niyas hige*), | 1 | - | - | 7.42 | - | - | 6.51 | - | - | .96 | - | - | 72.87 | - | - | 9.79 | 9.87 |
| *IV. Grains, Seeds, Fruits, etc.* | | | | | | | | | | | | | | | | | |
| Corn kernels, | 29 | 91.98 | 65.50 | 89.43 | 15.02 | 8.49 | 12.18 | 9.43 | 4.25 | 5.42 | 83.98 | 71.06 | 78.49 | 3.38 | 1.03 | 2.12 | 1.69 |
| Sweet corn kernels, | 1 | - | - | 88.02 | - | - | 12.57 | - | - | 9.56 | - | - | 73.83 | - | - | 2.41 | 1.68 |
| Wheat kernels, | 1 | - | - | 89.42 | - | - | 13.35 | - | - | 1.79 | - | - | 80.26 | - | - | 2.42 | 2.18 |

## *A. Analyses of Fodder Articles* — Continued.

| NAME. | Analyses. | DRY MATTER. | | | ONE HUNDRED PARTS OF DRY MATTER CONTAIN — | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PROTEIN. | | | FAT. | | | NITROGEN-FREE EXTRACT. | | | FIBRE. | | | Ash. |
| | | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | |
| *IV. Grains, Seeds, Fruits, etc.* — Concluded. | | | | | | | | | | | | | | | | | |
| Oat kernels, | 1 | - | - | 86.84 | - | - | 14.44 | - | - | 6.83 | - | - | 66.21 | - | - | 9.03 | 3.49 |
| Broom-corn seed, | 1 | - | - | 85.90 | - | - | 11.21 | - | - | 4.05 | - | - | 74.05 | - | - | 8.34 | 2.35 |
| Soja beans, | 3 | 94.15 | 80.73 | 85.83 | 35.98 | 32.58 | 33.97 | 21.89 | 18.42 | 20.19 | 34.88 | 32.87 | 33.98 | 7.57 | 5.15 | 6.02 | 5.84 |
| Horse beans, | 1 | - | - | 89.72 | - | - | 30.03 | - | - | 1.11 | - | - | 56.48 | - | - | 8.11 | 4.27 |
| Red adzinki beans, | 2 | 85.18 | 83.10 | 84.14 | 25.14 | 23.75 | 24.45 | .88 | .76 | .82 | 66.48 | 65.41 | 65.95 | 4.68 | 4.50 | 4.59 | 4.19 |
| Saddle beans, | 1 | - | - | 87.62 | - | - | 15.12 | - | - | 16.58 | - | - | 57.34 | - | - | 4.75 | 6.21 |
| Daidzu beans, | 1 | - | - | 88.47 | - | - | 38.99 | - | - | 18.59 | - | - | 30.41 | - | - | 4.97 | 7.04 |
| Millet seed, | 3 | 87.32 | 86.11 | 86.65 | 14.60 | 11.76 | 13.24 | 4.94 | 3.53 | 4.32 | 73.19 | 66.94 | 70.56 | 10.23 | 6.48 | 8.88 | 3.00 |
| Chestnuts, | 1 | - | - | 55.14 | - | - | 13.32 | - | - | 14.46 | - | - | 67.05 | - | - | 2.45 | 2.72 |
| Cranberries, | 1 | - | - | 10.59 | - | - | 4.40 | - | - | 5.61 | - | - | 76.37 | - | - | 11.63 | 1.99 |
| Apples, | 2 | 24.83 | 19.68 | 22.26 | 4.57 | 3.92 | 4.25 | 2.81 | 1.71 | 2.26 | 86.21 | 83.44 | 84.81 | 7.05 | 6.14 | 6.60 | 2.08 |
| *V. Flour and Meal.* | | | | | | | | | | | | | | | | | |
| Corn meal, | 34 | 89.95 | 79.81 | 86.24 | 16.08 | 9.73 | 11.04 | 5.08 | 3.10 | 3.83 | 83.61 | 73.20 | 81.41 | 3.60 | 1.20 | 2.15 | 1.57 |
| Corn and cob meal, | 37 | 94.00 | 80.89 | 89.47 | 15.06 | 7.82 | 10.01 | 5.27 | 3.36 | 4.19 | 81.41 | 70.13 | 76.62 | 10.41 | 5.63 | 7.54 | 1.64 |
| Cooked feed (oats and corn), | 1 | - | - | 94.45 | - | - | 14.75 | - | - | 5.34 | - | - | 67.14 | - | - | 8.73 | 4.04 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hominy meal, | 4 | – | – | **90.00** | 4.15 | 3.00 | **3.57** | .67 | .38 | **.57** | 63.62 | 60.58 | **61.72** | 33.77 | 31.36 | **32.93** | 1.21 |
| Ground oats, | 1 | – | – | **90.29** | – | – | **13.20** | – | – | **3.51** | – | – | **70.07** | – | – | **9.29** | 3.93 |
| Ground barley, | 4 | 89.09 | 82.59 | **86.44** | 14.93 | 10.42 | **12.46** | 2.38 | 1.69 | **2.10** | 78.25 | 74.47 | **76.83** | 7.37 | 4.10 | **5.84** | 2.77 |
| Broom-corn meal, | 1 | – | – | **86.46** | – | – | **11.14** | – | – | **4.13** | – | – | **74.30** | – | – | **8.00** | 2.43 |
| Pea meal, | 1 | – | – | **91.15** | – | – | **20.95** | – | – | **1.67** | – | – | **55.02** | – | – | **19.42** | 2.94 |
| Bean meal, | 1 | – | – | **88.02** | – | – | **12.57** | – | – | **9.56** | – | – | **73.83** | – | – | **2.41** | 1.63 |
| Soja-bean meal, | 1 | – | – | **89.20** | – | – | **41.18** | – | – | **18.17** | – | – | **30.60** | – | – | **5.01** | 5.04 |
| Millet meal (*Panicum Italicum*), | 1 | – | – | **89.38** | – | – | **35.12** | – | – | **17.35** | – | – | **38.95** | – | – | **3.86** | 4.72 |
| *VI. By-products and Refuse.* | | | | | | | | | | | | | | | | |
| Linseed cake, old process, | 8 | 92.52 | 88.50 | **90.32** | 39.97 | 33.98 | **36.65** | 9.87 | 6.24 | **7.30** | 44.72 | 37.76 | **40.51** | 9.69 | 8.04 | **8.62** | 6.92 |
| Linseed cake, new process, | 7 | 94.94 | 88.17 | **91.65** | 41.02 | 35.03 | **39.38** | 4.08 | 2.17 | **3.24** | 46.49 | 40.54 | **41.74** | 10.31 | 8.59 | **9.28** | 6.36 |
| Cotton-seed meal, | 24 | 94.42 | 88.81 | **91.94** | 51.79 | 36.54 | **44.22** | 14.72 | 9.47 | **12.15** | 35.84 | 20.22 | **29.30** | 10.83 | 5.08 | **7.70** | 7.53 |
| Wheat bran, | 40 | 92.58 | 86.30 | **89.34** | 20.54 | 15.67 | **17.86** | 6.08 | 2.80 | **4.98** | 62.83 | 51.77 | **58.36** | 14.26 | 7.49 | **10.98** | 7.82 |
| Spring-wheat bran, | 3 | 91.03 | 87.26 | **88.67** | 19.54 | 16.19 | **17.78** | 5.46 | 5.37 | **5.41** | 59.39 | 56.54 | **57.50** | 13.75 | 10.84 | **12.02** | 7.29 |
| Winter-wheat bran, | 2 | 87.76 | 86.94 | **87.35** | 17.04 | 16.24 | **16.64** | 4.57 | 3.43 | **4.00** | 62.83 | 59.83 | **61.33** | 12.74 | 9.32 | **11.03** | 7.00 |
| Wheat middlings, | 7 | 90.75 | 87.57 | **89.76** | 20.07 | 15.13 | **17.19** | 6.46 | 3.19 | **5.40** | 74.30 | 58.03 | **62.46** | 11.21 | 1.40 | **8.46** | 6.49 |
| Rye bran, | 2 | 91.82 | 86.30 | **89.06** | 18.98 | 16.52 | **17.75** | 3.03 | 2.07 | **2.55** | 73.56 | 69.21 | **71.70** | 4.54 | 3.46 | **4.00** | 4.30 |
| Rye middlings, | 1 | – | – | **87.46** | – | – | **13.15** | – | – | **5.61** | – | – | **73.52** | – | – | **3.70** | 4.02 |
| Pea bran, | 1 | – | – | **92.86** | – | – | **10.31** | – | – | **1.16** | – | – | **39.04** | – | – | **46.16** | 3.33 |
| Buckwheat middlings, | 1 | – | – | **88.49** | – | – | **25.49** | – | – | **7.53** | – | – | **66.36** | – | – | **5.18** | 5.44 |
| Gluten meal, | 38 | 93.67 | 68.32 | **90.98** | 39.28 | 25.75 | **29.99** | 14.47 | 3.92 | **9.13** | 66.26 | 48.26 | **56.34** | 10.06 | .41 | **3.59** | .95 |
| Gluten meal (Chicago), | 2 | 92.71 | 88.89 | **90.80** | 33.34 | 30.19 | **31.76** | 9.22 | 6.56 | **7.89** | – | – | **57.97** | – | – | **.73** | 1.65 |

## A. *Analyses of Fodder Articles* — Concluded.

| NAME. | Analyses. | DRY MATTER. | | | ONE HUNDRED PARTS OF DRY MATTER CONTAIN — PROTEIN. | | | FAT. | | | NITROGEN-FREE EXTRACT. | | | FIBRE. | | | Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | |
| *VI. By-products and Refuse* — Concluded. | | | | | | | | | | | | | | | | | |
| Gluten feed (Buffalo), | 10 | 93.67 | 90.61 | 91.90 | 31.05 | 21.11 | 25.69 | 14.47 | 9.18 | 12.08 | 62.79 | 48.80 | 53.12 | 10.06 | 5.43 | 7.00 | 1.11 |
| Gluten feed (Pope), | 1 | - | - | 86.02 | - | - | 38.68 | - | - | 16.34 | - | - | 42.43 | - | - | 1.80 | .75 |
| Maize feed (Chicago), | 3 | 91.40 | 90.25 | 90.95 | 29.40 | 21.33 | 25.47 | 7.90 | 6.15 | 6.96 | 62.12 | 53.85 | 58.27 | 9.65 | 7.93 | 8.53 | .77 |
| Starch feed (Pope), | 1 | - | - | 94.52 | - | - | 11.28 | - | - | 11.30 | - | - | 61.31 | - | - | 15.21 | .90 |
| Glucose feed (Richardson), | 1 | - | - | 93.68 | - | - | 23.12 | - | - | 11.67 | - | - | 52.41 | - | - | 11.67 | 1.13 |
| Corn-germ meal, | 1 | - | - | 90.65 | - | - | 28.26 | - | - | 11.82 | - | - | 42.49 | - | - | 9.18 | 8.25 |
| Corn-germ feed, | 1 | - | - | 92.45 | - | - | 10.81 | - | - | 12.17 | - | - | 62.10 | - | - | 14.05 | .87 |
| Corn screenings, | 1 | - | - | 88.98 | - | - | 8.29 | - | - | 4.48 | - | - | 81.57 | - | - | 3.27 | 2.39 |
| Proteina (mixed feed), | 4 | 93.20 | 89.94 | 91.61 | 27.23 | 20.53 | 23.67 | 8.24 | 5.01 | 7.20 | 61.53 | 51.11 | 55.55 | 12.33 | 10.18 | 10.92 | 2.66 |
| Excelsior feed, | 1 | - | - | 92.92 | - | - | 6.75 | - | - | 5.42 | - | - | 65.75 | - | - | 14.65 | 4.43 |
| Corn screenings, | 1 | - | - | 88.98 | - | - | 8.29 | - | - | 4.48 | - | - | 81.57 | - | - | 3.27 | 2.39 |
| Oat feed, | 2 | 90.66 | 90.53 | 90.59 | 15.60 | 14.06 | 14.83 | 8.23 | 4.28 | 6.25 | 68.08 | 64.52 | 66.31 | 8.79 | 8.06 | 8.42 | 4.19 |
| Rye feed, | 1 | - | - | 90.37 | - | - | 13.56 | - | - | 2.79 | - | - | 77.51 | - | - | 3.52 | 2.62 |
| Starch feed (Pope), | 1 | - | - | 94.52 | - | - | 11.28 | - | - | 11.30 | - | - | 61.31 | - | - | 15.21 | .90 |
| Cocoanut meal, | 1 | - | - | 90.67 | - | - | 22.61 | - | - | 12.88 | - | - | 40.03 | - | - | 18.80 | 5.68 |
| Louisiana rice bran, | 1 | - | - | 89.75 | - | - | 9.82 | - | - | 9.66 | - | - | 55.07 | - | - | 14.86 | 10.59 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bakery refuse, | 1 | - | - | 86.66 | - | - | 9.23 | - | - | 6.36 | - | - | 72.34 | - | - | .43 | 11.64 |
| Vinegar mash, | 1 | - | - | 5.51 | - | - | 16.50 | - | - | 8.45 | - | - | 63.47 | - | - | 8.55 | 3.03 |
| Refuse from starch works, | 1 | - | - | 42.96 | - | - | 22.41 | - | - | 10.17 | - | - | 58.98 | - | - | 7.54 | .90 |
| Oat meal and barley refuse, | 1 | - | - | 92.24 | - | - | 7.45 | - | - | 3.80 | - | - | 62.61 | - | - | 22.30 | 3.84 |
| Glucose refuse, | 1 | - | - | 93.29 | - | - | 21.06 | - | - | 10.55 | - | - | 62.42 | - | - | 4.77 | 1.20 |
| Spent brewers' grain, | 4 | 93.02 | 88.00 | 90.13 | 33.16 | 16.08 | 23.29 | 6.29 | 1.95 | 4.89 | 67.62 | 42.32 | 54.04 | 15.90 | 8.07 | 11.25 | 4.53 |
| Malt sprouts, | 1 | - | - | 84.63 | - | - | 27.17 | - | - | 3.85 | - | - | 47.92 | - | - | 14.75 | 6.31 |
| Damaged wheat, | 1 | - | - | 86.90 | - | - | 16.26 | - | - | 2.51 | - | - | 75.85 | - | - | 3.11 | 2.31 |
| Cocoa dust from cocoa manufactory, | 1 | - | - | 92.90 | - | - | 15.47 | - | - | 25.85 | - | - | 45.99 | - | - | 5.86 | 6.83 |
| Broom-corn waste, | 1 | - | - | 91.30 | - | - | 6.78 | - | - | 1.00 | - | - | 48.09 | - | - | 39.25 | 4.88 |
| Refuse from cows' manger, | 4 | 85.73 | 64.81 | 77.44 | 6.63 | 4.34 | 5.01 | 1.09 | .74 | .98 | 45.46 | 42.12 | 43.74 | 46.91 | 38.72 | 43.94 | 6.33 |
| Refuse from cows' manger (ensilage), | 6 | 39.89 | 21.73 | 27.07 | 11.56 | 8.64 | 8.38 | 2.04 | 1.30 | 1.48 | 44.96 | 41.67 | 45.97 | 40.37 | 33.98 | 34.57 | 9.60 |
| Cotton hulls, | 3 | 91.85 | 88.55 | 89.98 | 5.36 | 4.10 | 4.79 | 4.27 | 1.79 | 2.81 | 46.75 | 38.59 | 43.34 | 51.40 | 40.24 | 46.08 | 2.98 |
| Apple pomace, | 2 | 21.78 | 17.22 | 19.50 | 7.73 | 6.94 | 7.34 | 4.37 | 3.17 | 3.78 | 72.93 | 70.20 | 72.56 | 16.58 | 13.15 | 14.86 | 1.46 |
| Apple pomace ensilage, | 1 | - | - | 14.67 | - | - | 8.22 | - | - | 7.36 | - | - | 58.03 | - | - | 22.18 | 4.21 |
| Sugar beet pulp, from diffusion battery, | 1 | - | - | 10.32 | - | - | 12.41 | - | - | .95 | - | - | 61.86 | - | - | 23.74 | 1.04 |
| Corn cobs, | 6 | 94.05 | 90.00 | 92.35 | 4.15 | 1.46 | 2.91 | .77 | .38 | .56 | 63.62 | 58.78 | 61.21 | 37.84 | 31.36 | 33.96 | 1.36 |
| Palmetto root, | 1 | - | - | 88.49 | - | - | 3.82 | - | - | .53 | - | - | 69.95 | - | - | 21.26 | 4.44 |

## B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

| NAME. | Analyses. | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | *Valuation per 2,000 Pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *I. Green Fodders.* | | | | | | | | | | | | |
| Fodder corn, | 14 | 78.61 | .407 | 4.84 | .327 | .048 | .153 | .091 | .018 | .148 | .380 | $1 93 |
| Fodder corn ensilage, | 6 | 78.46 | .341 | - | .385 | .050 | .100 | .090 | .020 | .129 | .255 | 1 74 |
| Corn and soja-bean ensilage, | 1 | 71.03 | .790 | - | .444 | - | - | - | - | .420 | - | 3 67 |
| Ensilage of *Panicum miliaceum*, | 1 | 78.01 | .260 | - | .430 | - | - | - | - | .110 | .500 | 1 49 |
| Ensilage of *Panicum crus-galli*, | 1 | 76.75 | .294 | - | .621 | - | - | - | - | .133 | - | 1 84 |
| Sorghum, | 7 | 82.19 | .233 | - | .229 | .025 | .076 | .075 | .012 | .088 | .136 | 1 16 |
| White kibi, | 2 | 76.45 | .489 | 1.22 | .200 | .045 | .232 | .148 | .019 | .136 | .652 | 2 07 |
| Mochi millet, | 3 | 62.58 | .609 | 2.62 | .407 | .120 | .201 | .217 | .021 | .188 | .708 | 2 76 |
| Millet (*Panicum crus-galli*), | 1 | 75.11 | .455 | - | .494 | - | - | - | - | .109 | - | 2 24 |
| Green oats, | 3 | 83.36 | .489 | 1.31 | .381 | .217 | .154 | .134 | .018 | .130 | .496 | 2 26 |
| Green rye, | 2 | 72.03 | .302 | - | .636 | - | - | - | - | .117 | - | 1 87 |
| Vetch and oats, | 1 | 86.11 | .236 | 1.72 | .789 | .031 | .087 | .030 | .012 | .094 | .331 | 1 78 |
| Horse bean, | 1 | 74.71 | .675 | - | .346 | .028 | .346 | .157 | .050 | .083 | .514 | 2 85 |
| Soja bean, | 1 | 73.20 | .292 | - | .531 | - | - | - | - | .151 | - | 1 76 |
| Soja bean (early white), | 1 | 66.56 | .943 | - | .905 | - | - | - | - | .214 | - | 4 51 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soja bean (early green), | 1 | 69.84 | .835 | - | .707 | - | - | - | - | .201 | - | 3 90 |
| Soja bean (medium black), | 1 | 76.87 | .803 | - | .566 | - | - | - | - | .175 | - | 3 61 |
| Soja bean (late), | 1 | 79.78 | .600 | - | .677 | - | - | - | - | .138 | - | 2 98 |
| Kidney vetch, | 1 | 80.85 | .563 | - | .346 | .218 | .907 | .055 | .027 | .085 | .155 | 2 46 |
| Cow-pea vines, | 1 | 78.81 | .274 | 1.47 | .306 | .063 | .300 | .099 | .016 | .098 | .077 | 1 39 |
| Prickley comfrey, | 1 | 86.79 | .370 | - | .759 | .122 | .309 | .041 | .058 | .115 | - | 2 24 |
| Serradella, | 2 | 82.59 | .411 | 1.82 | .420 | .097 | .460 | .067 | .021 | .140 | .097 | 2 04 |
| Common buckwheat, | 1 | 84.65 | .440 | - | .538 | - | - | - | - | .089 | .577 | 2 22 |
| Flat pea (*Lathyrus sylvestris*), | 1 | 78.62 | 1.049 | - | .449 | - | .302 | .088 | .056 | .140 | .247 | 4.30 |
| Hungarian grass, | 1 | 74.31 | .386 | - | .549 | - | - | - | - | .159 | - | 2 11 |
| White lupine, | 1 | 85.35 | .440 | - | .253 | .100 | .450 | .107 | .025 | .051 | .131 | 1 87 |
| Yellow lupine, | 1 | 85.05 | .398 | - | .441 | .086 | .288 | .049 | .008 | .092 | .161 | 1 49 |
| Spanish moss, | 1 | 60.80 | .279 | 1.04 | .255 | .263 | .089 | .122 | .029 | .030 | .191 | 1 30 |
| *II. Hay and Dry Coarse Fodders.* | | | | | | | | | | | | |
| English hay, | 10 | 11.94 | 1.294 | 6.34 | 1.528 | .110 | .344 | .240 | .021 | .286 | .911 | 6 49 |
| Rowen, | 12 | 18.52 | 1.609 | 9.57 | 1.486 | .140 | .640 | .280 | .034 | .432 | 1.840 | 7 70 |
| Timothy hay, | 3 | 11.26 | 1.240 | 4.93 | 1.460 | .180 | .620 | .120 | .006 | .342 | 1.000 | 6 28 |
| Red-top, | 4 | 7.71 | 1.150 | 4.59 | 1.020 | .438 | .571 | .134 | .036 | .360 | 1.736 | 5 51 |
| Kentucky blue grass, | 2 | 5.34 | 1.320 | - | 1.694 | .129 | .398 | - | .044 | .431 | 2.863 | 6 91 |

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* The valuation is based on the following prices per pound of the essential fertilizing ingredients: nitrogen, 17½ cents; potassium oxide, 5½ cents; phosphoric acid, 5 cents.

### B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Continued.

| NAME. | Analyses. | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | *Valuation per 2,000 Pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *II. Hay and Dry Coarse Fodders* — Concluded. | | | | | | | | | | | | |
| Orchard grass, . . . . . . . . . . . . | 4 | 8.84 | 1.310 | 6.42 | 1.879 | .225 | .456 | .297 | .033 | .414 | 2.060 | $7 07 |
| Meadow fescue, . . . . . . . . . . . | 6 | 8.89 | .992 | 8.08 | 2.096 | .301 | .576 | .187 | .028 | .399 | 1.537 | 6 18 |
| Perennial rye-grass, . . . . . . . . . . | 2 | 9.13 | 1.227 | 6.79 | 1.553 | .307 | .642 | .337 | .044 | .559 | 2.262 | 6 56 |
| Italian rye-grass, . . . . . . . . . . . | 4 | 8.71 | 1.189 | - | 1.273 | .451 | .857 | .321 | .071 | .556 | 2.598 | 6 13 |
| Salt hay, . . . . . . . . . . . . . | 1 | 5.36 | 1.180 | - | .718 | .017 | .371 | .335 | .028 | .248 | - | 4 46 |
| Japanese millet (white head), . . . . . . . | 3 | 10.45 | 1.105 | 5.80 | 1.223 | .012 | .465 | .377 | .028 | .403 | 1.033 | 5 62 |
| Common buckwheat, . . . . . . . . . . | 1 | 8.50 | 2.620 | - | 3.208 | - | - | - | - | .532 | 3.436 | 13 04 |
| Silver-hull buckwheat, . . . . . . . . . . | 1 | 8.91 | 1.780 | - | 2.380 | - | 2.290 | .526 | .059 | .860 | .462 | 9 71 |
| Japanese buckwheat, . . . . . . . . . . | 1 | 5.72 | 1.629 | - | 3.320 | .349 | 3.418 | .421 | .148 | .852 | .378 | 10 21 |
| Fodder corn, . . . . . . . . . . . . | 7 | 7.85 | 1.763 | 4.91 | .889 | .175 | .605 | .500 | .075 | .542 | 1.270 | 7 69 |
| Corn stover, . . . . . . . . . . . . | 17 | 9.33 | 1.038 | 3.74 | 1.375 | .112 | .622 | .384 | .068 | .288 | 1.782 | 5 43 |
| Teosinte, . . . . . . . . . . . . . | 1 | 6.06 | 1.460 | 6.53 | 3.696 | .109 | 1.597 | .458 | .021 | .546 | .315 | 9 72 |
| Summer rape, . . . . . . . . . . . . | 1 | 11.13 | 2.053 | - | 4.670 | .994 | 3.691 | .522 | .031 | .572 | .709 | 12 89 |
| Millet hay, . . . . . . . . . . . . | 1 | 9.75 | 1.280 | - | 1.690 | .020 | .500 | .460 | .030 | .490 | 1.360 | 6 83 |
| Mammoth red clover, . . . . . . . . . . | 3 | 11.41 | 2.231 | 8.72 | 1.223 | .389 | 3.141 | .613 | .111 | .546 | .779 | 9 98 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Medium red clover, | 2 | 7.91 | 2.184 | 8.36 | 2.286 | .210 | 1.689 | .402 | .099 | .447 | .919 | 10 61 |
| Alsike clover, | 6 | 9.94 | 2.342 | 11.11 | 2.227 | .309 | 2.153 | .537 | .197 | .668 | 1.776 | 11 31 |
| Lucerne (alfalfa), | 4 | 6.26 | 2.075 | 6.82 | 1.461 | .814 | 2.211 | .406 | .078 | .526 | .513 | 9 40 |
| Bokhara clover, | 2 | 7.43 | 1.975 | 7.70 | 1.832 | .114 | 1.784 | .347 | .023 | .558 | .057 | 9 49 |
| Blue melilot, | 1 | 8.22 | 1.919 | 13.65 | 2.796 | .270 | 1.449 | .260 | .349 | .544 | 4.008 | 10 34 |
| Sainfoin, | 1 | 12.17 | 2.630 | 7.55 | 2.020 | .540 | 1.160 | .430 | .040 | .760 | .470 | 12 19 |
| Sulla, | 2 | 9.39 | 2.460 | - | 2.093 | .223 | 2.497 | .350 | .114 | .453 | .614 | 11 37 |
| *Lotus villosus*, | 2 | 11.52 | 2.095 | 8.23 | 1.807 | .499 | 2.220 | .476 | .112 | .594 | .976 | 9 91 |
| Soja bean, | 2 | 6.30 | 2.320 | 6.47 | 1.079 | .148 | 2.760 | 1.178 | .115 | .667 | .977 | 9 97 |
| Cow pea, | 1 | 9.00 | 1.635 | 8.40 | .913 | .122 | 2.696 | .688 | .046 | .527 | .832 | 7 25 |
| Small pea, | 1 | 5.80 | 2.497 | - | 1.990 | .469 | 1.373 | .276 | .138 | .592 | 1.081 | 11 52 |
| Flat pea (*Lathyrus sylvestris*), | 1 | 8.90 | 3.514 | - | 2.340 | - | 1.631 | .454 | .179 | .820 | 1.830 | 15 69 |
| Serradella, | 2 | 7.39 | 2.697 | 10.60 | .652 | .656 | 2.545 | .461 | .066 | .777 | .590 | 11 97 |
| Scotch tares, | 1 | 15.80 | 2.964 | - | 3.004 | .238 | 1.698 | .354 | .460 | .815 | 4.062 | 14 49 |
| Spring vetch, | 1 | 8.21 | 2.204 | - | 2.760 | - | 1.710 | - | - | .740 | .510 | 11 48 |
| Vetch and oats, | 3 | 9.91 | 1.299 | 9.58 | 1.349 | .420 | .663 | .265 | .098 | .560 | .521 | 6 59 |
| Soja-bean straw, | 1 | 13.00 | .714 | - | 1.060 | - | .436 | .469 | .035 | .259 | .218 | 3 92 |
| Millet straw, | 1 | 13.45 | .690 | - | 1.760 | - | - | - | - | .180 | .580 | 4 63 |
| White daisy, | 1 | 9.65 | .279 | 6.37 | 1.253 | .164 | 1.302 | .191 | .032 | .435 | 1.110 | 2 78 |
| Dry carrot tops, | 1 | 9.76 | 3.130 | 12.52 | 4.883 | 4.028 | 2.089 | .667 | .118 | .612 | *.098 | 16 94 |
| Barley straw, | 1 | 11.44 | 1.310 | 5.30 | 2.086 | .183 | .572 | .180 | - | .303 | 2.380 | 7 18 |

* See note on page 359.

### B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Continued.

| NAME. | Analyses. | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | Valuation per 2,000 Pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *III. Roots, Bulbs, Tubers, etc.* | | | | | | | | | | | | |
| Beets, red, | 8 | 87.82 | .229 | 1.13 | .440 | .091 | .049 | .033 | .004 | .092 | .020 | $1 37 |
| Beets, sugar, | 4 | 86.95 | .223 | 1.04 | .477 | .081 | .057 | .040 | .013 | .101 | .048 | 1 40 |
| Beets, yellow fodder, | 1 | 90.60 | .192 | .95 | .462 | .104 | .045 | .030 | .005 | .086 | .015 | 1 26 |
| Mangolds, | 2 | 87.29 | .188 | 1.22 | .383 | .125 | .061 | .039 | .005 | .093 | .023 | 1 17 |
| Ruta-bagas, | 3 | 89.13 | .190 | 1.06 | .489 | .070 | .088 | .030 | .004 | .123 | .012 | 1 33 |
| Turnips, | 3 | 89.29 | .163 | 1.01 | .381 | .078 | .089 | .027 | .009 | .115 | .112 | 1 10 |
| Carrots, | 2 | 89.03 | .162 | 9.22 | .471 | .062 | .067 | .023 | .009 | .090 | .040 | 1 23 |
| Parsnips, | 1 | 80.34 | .217 | - | .617 | .006 | .088 | .045 | .005 | .187 | .019 | 1 63 |
| Potatoes, | 1 | 79.75 | .207 | .99 | .294 | .013 | .007 | .020 | .002 | .066 | .006 | 1 11 |
| Artichokes, | 1 | 77.49 | .460 | - | .484 | - | - | - | - | .168 | .039 | 2 31 |
| Japanese radish (*merinia*), | 1 | 93.26 | .081 | - | .281 | - | - | - | - | .047 | - | 0 64 |
| Japanese radish (*niyas hige*), | 1 | 92.58 | .077 | - | .338 | - | - | - | - | .050 | - | 0 79 |
| *IV. Grains.* | | | | | | | | | | | | |
| Corn kernels, | 13 | 10.88 | 1.822 | 1.53 | .404 | .034 | .032 | .206 | .019 | .699 | .020 | 7 52 |
| Corn and cob meal, | 29 | 8.96 | 1.409 | - | .472 | .059 | .018 | .176 | .011 | .571 | .430 | 6 02 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oat kernels, | 1 | 9.04 | 2.100 | - | - | - | - | - | - | - | - | - |
| Soja beans, | 2 | 18.33 | 5.303 | 4.99 | 1.991 | .275 | .419 | .909 | .216 | 1.869 | .093 | 22 63 |
| Red adzinki beans, | 1 | 14.82 | 3.240 | - | 1.540 | .035 | .090 | .210 | .180 | .940 | .050 | 14 07 |
| White adzinki beans, | 1 | 16.90 | 3.330 | - | 1.480 | .190 | .130 | .220 | .021 | .970 | .130 | 14 14 |
| Saddle beans, | 1 | 12.38 | 2.120 | - | 2.130 | .020 | .250 | .430 | .032 | 1.520 | .250 | 11 28 |
| Daidzu beans, | 1 | 11.53 | 5.520 | - | 1.960 | .210 | .220 | .400 | .050 | 1.480 | .280 | 22 96 |
| Japanese millet, | 2 | 13.68 | 1.730 | - | .380 | .030 | .045 | .225 | .015 | .685 | - | 7 16 |
| Common millet, | 1 | 12.68 | 2.040 | - | .360 | .060 | .040 | .260 | .030 | .850 | .143 | 8 38 |
| Chestnuts, | 1 | 44.86 | 1.175 | 2.72 | .632 | - | .060 | .135 | .010 | .392 | .069 | 5 51 |
| Cranberries, | 1 | 89.41 | .075 | - | .097 | - | .018 | .013 | .005 | .028 | - | 0 40 |
| Apples, | 2 | 79.91 | .130 | .41 | .190 | .030 | .030 | .030 | .003 | .010 | .003 | 0 57 |
| *V. Flour and Meal.* | | | | | | | | | | | | |
| Corn meal, | 3 | 14.13 | 1.920 | 1.42 | .337 | .064 | .034 | .187 | .015 | .714 | .060 | 7 80 |
| Hominy feed, | 1 | 8.93 | 1.630 | 2.21 | .490 | - | .180 | .280 | - | .980 | - | 7 22 |
| Ground barley, | 1 | 13.43 | 1.550 | 2.06 | .341 | .169 | .091 | .173 | .013 | .660 | .669 | 6 46 |
| Wheat flour, | 2 | 12.14 | 2.020 | 1.22 | .359 | - | .170 | .050 | - | .352 | - | 8 89 |
| Pea meal, | 1 | 8.85 | 3.080 | 2.68 | .993 | .618 | .302 | .302 | .027 | .820 | .122 | 12 69 |
| Soja-bean meal, | 1 | 10.80 | 5.89 | - | 2.230 | - | - | - | - | 1.570 | .280 | 24 64 |
| *VI. By-products and Refuse.* | | | | | | | | | | | | |
| Linseed meal, old process, | 4 | 8.02 | 5.390 | 6.57 | 1.214 | .860 | .664 | .763 | .060 | 1.780 | .340 | 21 98 |
| Linseed meal, new process, | 5 | 7.96 | 5.828 | 5.04 | 1.246 | .823 | .663 | .655 | .062 | 1.692 | .345 | 24 26 |

* See note on page 359.

## B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Concluded.

| NAME. | Analyses. | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | Valuation per 2,000 Pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *VI. By-products and Refuse.* — Concluded. | | | | | | | | | | | | |
| Cotton-seed meal, | 15 | 8.83 | 6.494 | 6.49 | 1.686 | .291 | .587 | .589 | .020 | 2.366 | .322 | $26 84 |
| Wheat bran, | 8 | 11.07 | 2.620 | 6.44 | 1.579 | .159 | .168 | .899 | .019 | 2.461 | .182 | 13 37 |
| Wheat middlings, | 2 | 10.15 | 2.745 | 2.30 | .750 | .110 | .200 | .210 | - | 1.245 | - | 11 67 |
| Rye middlings, | 1 | 12.54 | 1.840 | 3.52 | .810 | .030 | .090 | .320 | .020 | 1.260 | .170 | 8 59 |
| Rye feed, | 1 | 9.63 | 1.950 | - | .980 | - | - | - | - | 1.561 | - | 9 46 |
| Gluten meal, | 5 | 8.53 | 5.090 | .65 | .047 | .018 | .050 | .035 | .009 | .420 | - | 18 28 |
| Gluten feed (Buffalo), | 4 | 8.11 | 3.724 | - | .060 | - | - | - | - | .348 | .160 | 13 45 |
| Spent brewers' grain, | 2 | 8.58 | 2.680 | 6.15 | .853 | .347 | .296 | .286 | .159 | 1.045 | 1.770 | 11 36 |
| Proteina, | 1 | 10.06 | 2.970 | - | .570 | - | - | - | - | 1.00 | - | 12 02 |
| Damaged wheat, | 1 | 13.10 | 2.260 | - | .505 | - | - | - | - | .831 | - | 9 30 |
| Louisiana rice bran, | 1 | 10.25 | 1.430 | - | .840 | - | - | - | - | 1.710 | - | 7 64 |
| Glucose refuse, | 1 | 6.71 | 3.370 | - | .090 | - | - | - | - | .610 | - | 12 50 |
| Cocoa dust, | 1 | 7.10 | 2.299 | 6.35 | .630 | - | .630 | - | - | 1.340 | - | 10 08 |
| Broom-corn waste (stalks), | 1 | 10.37 | .870 | 4.70 | 1.858 | - | .242 | .170 | - | .460 | 1.000 | 5 55 |
| Cotton hulls, | 3 | 10.63 | .750 | 2.61 | 1.080 | - | .200 | .260 | - | .180 | .060 | 3 99 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apple pomace, | 2 | 80.50 | .227 | .271 | .134 | .026 | .037 | .028 | .008 | .018 | .009 | 0 96 |
| Corn cobs, | 8 | 12.09 | .504 | .815 | .598 | .071 | .025 | .045 | .009 | .063 | .190 | 2 48 |
| Palmetto roots, | 1 | 11.51 | .540 | 3.93 | 1.380 | .345 | .045 | .004 | .017 | .157 | .410 | 3 57 |
| Buckwheat hulls, | 1 | 11.90 | .490 | - | .521 | - | .247 | .236 | .020 | .073 | .066 | 2 36 |
| *VII. Dairy Products.* | | | | | | | | | | | | |
| Buttermilk, | 1 | 91.13 | .510 | .810 | .046 | - | .045 | - | - | .041 | - | 1 88 |
| Skim-milk, | 19 | 90.29 | .586 | .788 | - | - | - | - | - | - | - | - |
| Whey, | 1 | 93.68 | .102 | - | .0723 | - | - | - | - | .173 | - | 0 62 |

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* See note on page 359.

## C. *Analyses of Fruits.*

| NAME. | Date. | Dry Matter. | Specific Gravity of Juice. | Temperature C. of Juice (Degrees). | Total Sugar in Juice. | Glucose in Juice. | Cane Sugar in Juice. | *Soda Sol. required to neutralize 100 parts Juice. |
|---|---|---|---|---|---|---|---|---|
| | **1877.** | Per ct. | | | Per ct. | Per ct. | Per ct. | C. C. |
| Apple (Baldwin), | Sept. 1, | 20.14 | 1.055 | 12—15 | 3.09 | – | – | – |
| Apple (Baldwin), | Oct. 9, | 19.66 | 1.065 | 12—15 | 6.25 | – | – | – |
| Apple (Baldwin), | Nov. 27, | – | 1.075 | 12—15 | 10.42 | – | – | – |
| Rhode Island Greening, | Sept. 1, | 20.27 | 1.055 | 12—15 | 3.16 | – | – | – |
| Rhode Island Greening, | Oct. 9, | 19.68 | 1.066 | 12—15 | 7.14 | – | – | – |
| Rhode Island Greening,† | Nov. 27, | 20.25 | 1.080 | 12—15 | 11.36 | – | – | – |
| Pear (Bartlett), | Aug. 31, | 15.00 | 1.060 | 12—15 | 4.77 | – | – | – |
| Pear (Bartlett), | Sept. 7, | 16.55 | 1.060 | 12—15 | 5.68 | – | – | – |
| Pear (Bartlett), | Sept. 20, | – | 1.065 | 12—15 | 8.62 | – | – | – |
| Pear (Bartlett),‡ | Sept. 22, | – | 1.060 | 12—15 | 8.93 | – | – | – |
| Cranberries, | – | 10.71 | 1.025 | 15 | 1.35 | – | – | –§ |
| Cranberries, | 1878. | 10.11 | 1.025 | 15 | 1.70 | – | – | –‖ |
| Early York Peach (ripe), | – | – | 1.045 | 25 | – | 1.92 | 6.09 | 45 |
| Early York Peach (nearly ripe), | – | 10.96¶ | 1.039 | 25 | – | 1.36 | 4.12 | 42.3 |
| Crawford Peach (nearly ripe), | – | – | 1.050 | 18 | – | 2.19 | 7.02 | 85.6 |
| Crawford Peach (mellow), | – | 11.36¶ | 1.055 | 18 | – | 1.70 | 8.94 | 76 |
| Crawford Peach (not mellow), | – | 11.88¶ | 1.045 | 22 | – | 1.67 | 5.92 | 64 |

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* One part $Na_2$ $CO_3$ in 100 parts of water.

† Picked October 9.

‡ Picked September 7.

§ Free acid, 2.25 per cent.

‖ Free acid, 2.43 per cent.

¶ In pulp, kept ten days before testing.

## C. *Analyses of Fruits* — Continued.

[Wild and cultivated grapes.]

| NAME. | Date. | Specific Gravity. | Temperature C. (Degrees). | Dry Matter. | Glucose in Juice. | Sugar in Dry Matter. | *Soda Sol. required to neutralize 100 parts Juice. |
|---|---|---|---|---|---|---|---|
| | **1876.** | | | Per ct. | Per ct. | Per ct. | C.C. |
| Concord, . . . . . . . | July 17, | 1.0175 | 31 | 8.30 | .645 | 7.77 | – |
| Concord, . . . . . . . | July 20, | 1.0150 | 31 | 8.10 | .625 | 7.72 | 216 |
| Concord, . . . . . . . | Aug. 2, | 1.0200 | 25 | 9.94 | .938 | 9.44 | 249 |
| Concord, . . . . . . . | Aug. 16, | 1.0250 | 28 | 10.88 | 2.000 | 18.38 | 229 |
| Concord, . . . . . . . | Aug. 30, | 1.0500 | 25 | 15.58 | 8.620 | 55.33 | 120 |
| Concord, . . . . . . . | Sept. 13, | 1.0670 | 23 | 17.48 | 13.890 | 79.46 | 55 |
| Concord, . . . . . . . | Sept. 4, | 1.0700 | 18 | 19.82 | 16.130 | 81.38 | 49.2 |
| Wild Purple Grape, . . . . | July 19, | 1.020 | 31 | 9.00 | .714 | 7.93 | 204 |
| Wild Purple Grape, . . . . | Aug. 4, | 1.020 | 28 | 12.25 | 1.100 | 8.98 | 246 |
| Wild Purple Grape, . . . . | Aug. 16, | 1.025 | 28 | 12.48 | 2.000 | 16.03 | 233 |
| Wild Purple Grape, . . . . | Aug. 30, | 1.050 | 26 | 16.58 | 6.500 | 39.81 | 147.6 |
| White Wild Grape, . . . . | Aug. 31, | 1.050 | 26 | 16.48 | 9.260 | 56.18 | 98 |
| Hartford Prolific, . . . . . | Sept. 5, | 1.060 | 22 | 17.39 | 13.89 | 79.87 | 88.8 |
| Ives' seedling, . . . . . . | Sept. 6, | 1.070 | 26 | 20.15 | 15.15 | 75.14 | 88.6 |
| Iona, . . . . . . . . | Sept. 7, | 1.080 | 21 | 24.56 | 15.15 | 61.68 | 144 |
| Iona (mildewed), . . . . . | Sept. 7, | 1.045 | 26 | 15.41 | 6.25 | 40.56 | 204.4 |
| Agawam, . . . . . . . | Sept. 11, | 1.075 | 20 | 20.79 | 17.24 | 82.92 | 94.8 |
| Wilder, . . . . . . . . | Sept. 11, | 1.064 | 20 | 16.53 | 13.67 | 82.69 | 56 |
| Delaware, . . . . . . . | Sept. 12, | 1.080 | 24 | 23.47 | 17.86 | 76.09 | 74 |
| Charter Oak, . . . . . . | Sept. 12, | 1.080 | 24 | 15.98 | 8.77 | 54.94 | 168.3 |
| Israella, . . . . . . . . | Sept. 16, | 1.075 | 23 | 19.67 | 9.20 | 46.77 | 89.8 |
| Bent's Seedling, . . . . . | Sept. 20, | 1.080 | 21 | 20.65 | 16.13 | 78.11 | 181.8 |
| Adirondack, . . . . . . . | Sept. 20, | 1.065 | 21 | 15.11 | 13.17 | 87.16 | 68 |
| Catawba, . . . . . . . . | Oct. 16, | 1.080 | 13 | 23.45 | 17.39 | 74.16 | 82 |
| | **1877.** | | | | | | |
| Wilder, . . . . . . . . | Sept. 11, | 1.065 | 23 | 16.41 | 15.15 | 92.32 | 60 |
| Charter Oak, . . . . . . | Sept. 12, | 1.055 | 23 | 16.22 | 9.80 | 60.42 | 96 |
| Concord, . . . . . . . . | Sept. 13, | 1.065 | 24 | 15.90 | 13.16 | 82.76 | 102 |
| Concord, . . . . . . . . | Sept. 26, | 1.075 | 24 | 19.34 | 15.43 | 79.78 | 70.8 |
| Eumalan, . . . . . . . . | Sept. 24, | 1.065 | 16 | 19.62 | 13.16 | 67.07 | 73 |
| Wild White Grape, . . . . | Sept. 5, | 1.050 | 22 | 15.57 | 7.20 | 46.24 | 140.8 |
| Wild White Grape (shrivelled), . | Sept. 20, | 1.060 | 16 | 20.02 | 10.00 | 49.95 | 130 |
| Wild Purple Grape (shrivelled), . | Sept. 20, | 1.045 | 16 | 16.69 | 8.22 | 49.25 | 104 |

* One part of pure $Na_2\ CO_3$ in 100 parts water.

## *C. Analyses of Fruits* — Continued.

[Effect of girdling on grapes.]

| NAME AND CONDITION. | Date. | Specific Gravity. | Temperature C. (Degrees). | Dry Matter at 100° C. | Glucose in Juice. | Sugar in Dry Matter. | *Soda Sol. required to neutralize 100 parts Juice. |
|---|---|---|---|---|---|---|---|
| | 1877. | | | Per ct. | Per ct. | Per ct. | C. C. |
| Hartford Prolific, not girdled, | Sept. 3, | 1.045 | 19 | 12.85 | 8.77 | 68.25 | 111.4 |
| Hartford Prolific, girdled, | Sept. 3, | 1.065 | 19 | 17.18 | 12.50 | 72.76 | 100 |
| Wilder, not girdled, | Sept. 3, | 1.055 | 19 | 15.41 | 10.42 | 67.62 | 108.2 |
| Wilder, girdled, | Sept. 3, | 1.075 | 19 | 17.24 | 14.70 | 85.26 | 88.4 |
| Delaware, not girdled, | Sept. 4, | 1.065 | 19 | 15.75 | 11.76 | 74.66 | 101.2 |
| Delaware, girdled, | Sept. 4, | 1.075 | 19 | 19.14 | 15.15 | 79.16 | 94.4 |
| Agawam, not girdled, | Sept. 4, | 1.060 | 19 | 16.60 | 11.37 | 68.48 | 128.2 |
| Agawam, girdled, | Sept. 4, | 1.075 | 19 | 18.45 | 16.31 | 87.42 | 114.8 |
| Iona, not girdled, | Sept. 6, | 1.0625 | 22 | 16.60 | 13.51 | 68.31 | 131.4 |
| Iona, girdled, | Sept. 6, | 1.085 | 22 | 21.48 | 15.63 | 72.76 | 125.6 |
| Concord, not girdled, | Sept. 6, | 1.045 | 22 | 13.46 | 7.46 | 55.42 | 182.4 |
| Concord, girdled, | Sept. 6, | 1.070 | 22 | 17.53 | 13.88 | 79.18 | 102.8 |
| Concord, not girdled, | Sept. 26, | 1.065 | 22 | 17.63 | 13.70 | 78.27 | 86 |
| Concord, girdled, | Sept. 26, | 1.080 | 22 | 24.47 | 19.61 | 80.13 | 76.8 |
| Concord, not girdled, | Oct. 5, | 1.075 | 12 | 20.92 | 17.50 | 85.37 | 42 |
| Concord, girdled, | Oct. 5, | 1.085 | 12 | – | 17.86 | – | 54 |

| | Date. | 100 Parts of Grapes contained — | | | |
|---|---|---|---|---|---|
| | | Ash. | Moisture. | Glucose. | Tartaric Acid. |
| | 1889. | | | | |
| Concord, not girdled, | Sept. 23, | – | 84.69 | 6.24 | .75 |
| Concord, girdled, | Sept. 23, | .42 | 83.00 | 8.13 | .85 |
| Concord, not girdled, | Oct. 8, | .53 | 84.51 | 6.09 | .48 |
| Concord, girdled, | Oct. 8, | .37 | 82.69 | 8.50 | .50 |
| | 1890. | | | | |
| Concord, not girdled, | Sept. 25, | .47 | 86.49 | 7.36 | 1.15 |
| Concord, girdled, | Sept. 25, | .48 | 84.93 | 9.29 | 1.17 |
| Concord, not girdled, | Oct. 9, | .53 | 85.39 | 7.67 | .71 |
| Concord, not girdled, | Oct. 9, | .59 | 85.11 | 6.65 | .51 |
| Concord, girdled, | Oct. 9, | .54 | 85.15 | 9.12 | .74 |

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* One part of pure $Na_2 CO_3$ in 100 parts water.

## *C. Analyses of Fruits* — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

| NAME. | Date. | Dry Matter. | Specific Gravity. | Temperature C. (Degrees). | Per Cent. of Glucose. | Per Cent. of Acids. | Remarks. |
|---|---|---|---|---|---|---|---|
| | **1877.** | | | | | | |
| Wild Purple Grape Berries, . | Sept. 20, | 16.31 | – | – | 8.03 | – | Unfertilized. |
| Wild Purple Grape Berries, . | " | 19.55 | – | – | 13.51 | – | Fertilized. |
| Wild Purple Grape Juice, . | " | – | 1.045 | 16 | 8.22 | 9 840 | Unfertilized. |
| Wild Purple Grape Juice, . | " | – | 1.065 | 16 | 13.51 | 1.149 | Fertilized. |
| Wild White Grape Berries, . | " | 20.02 | – | – | – | – | Unfertilized. |
| Wild White Grape Berries, . | " | 21.65 | – | – | – | – | Fertilized. |
| Wild White Grape Juice, . | " | – | 1.060 | 16 | 10.00 | 1.846 | Unfertilized. |
| Wild White Grape Juice, . | " | – | – | – | 14.29 | .923 | Fertilized. |

[Effect of fertilization upon the ash constituents of grapes.]

| NAME. | Date. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | **1876.** | | | | | | | | |
| Wild Purple Grapes, | Sept. 13, | 50.93 | .15 | 22.23 | 5.59 | .79 | 17.40 | 2.93 | Unfertilized. |
| Wild Purple Grapes, | Sept. 20, | 62.65 | .85 | 14.24 | 3.92 | .53 | 13.18 | 4.63 | Fertilized. |
| Concord Grapes, . | July 7, | 41.73 | 5.04 | 25.03 | 7.80 | .55 | 18.48 | 1.37 | Unfertilized. |
| Concord Grapes, . | July 17, | 47.34 | 1.13 | 24.21 | – | .75 | 21.38 | .43 | Unfertilized. |
| Concord Grapes, . | Aug. 18, | 51.14 | 3.19 | 16.20 | 6.38 | .65 | 20.77 | 1.67 | Unfertilized. |
| Concord Grapes, . | Sept. 13, | 57.15 | 4.17 | 11.30 | 3.10 | .40 | 12.47 | 11.82 | Unfertilized. |
| | **1878.** | | | | | | | | |
| Concord Grapes, . | Oct. 3, | 64.65 | 1.42 | 9.13 | 3.63 | .50 | 14.87 | 5.80 | Fertilized. |

## *C. Analyses of Fruits* — Concluded.

[Ash analyses of fruits and garden crops.]

| NAME. | Ash. | 100 PARTS OF ASH CONTAINED — | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Potash. | Soda. | Lime. | Magnesia. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. |
| Concord Grape (fruit), | – | 51.14 | 3.19 | 16.20 | 6.38 | .65 | 20.77 | 1.67 |
| Unfermented juice, | – | 50.85 | .48 | 3.69 | 4.25 | .10 | 6.43 | .90 |
| Fermented juice, | – | 40.69 | – | 6.85 | 6.24 | – | 9.04 | – |
| Skins and pulp, | – | 7.70 | .42 | 57.36 | 8.80 | .08 | 24.40 | 1.32 |
| Seeds, | 3.08 | 6.71 | – | – | 3.03 | – | 17.20 | .29 |
| Stems of grapes, | 4.69 | 20.91 | – | 20.20 | 8.45 | – | 17.75 | 2.09 |
| Young branches,* | – | 24.71 | .94 | 40.53 | 10.66 | 1.08 | 17.16 | 4.92 |
| Wood of vine,† | 2.97 | 22.57 | – | 9.72 | 4.28 | – | 14.07 | 23.84 |
| Concord Grapes, 1891,‡ | .55 | 49.76 | – | 3.50 | 2.53 | 1.19 | 13.56 | 2.01 |
| Clinton Grape (fruit), | – | 58.45 | 3.51 | 13.34 | 7.37 | .90 | 18.19 | – |
| Baldwin Apple, | – | 63.54 | 1.71 | 7.28 | 5.52 | 1.08 | 20.87 | 3.68 |
| Strawberry (fruit),§ | .52 | 49.24 | 3.23 | 13.47 | 8.12 | 1.74 | 18.50 | 5.66 |
| Strawberry (fruit),‖ | – | 58.47 | – | 14.64 | 6.12 | 3.37 | 17.40 | – |
| Strawberry vines, | 3.34 | 10.62 | 13.35 | 36.63 | 3.83 | 6.91 | 14.48 | 14.17 |
| Cranberry (fruit), | .18 | 47.96 | 6.58 | 18.58 | 6.78 | – | 14.27 | – |
| Cranberry vines, | 2.45 | 12.98 | 3.27 | 16.49 | 10.33 | 3.35 | 10.94 | 34.04 |
| Currants, red, | .47 | 47.68 | 4.02 | 18.96 | 6.23 | 1.20 | 21.91 | – |
| Currants, white, | .59 | 52.79 | 3.00 | 17.08 | 5.68 | 2.67 | 18.78 | – |
| Crawford Peach, sound, | – | 74.46 | – | 2.64 | 6.29 | .58 | 16.02 | – |
| Crawford Peach, diseased,¶ | – | 71.30 | – | 4.68 | 5.49 | .46 | 18.07 | – |
| Branch, sound, | – | 26.01 | – | 54.52 | 7.58 | .52 | 11.37 | – |
| Branch, diseased,¶ | – | 15.67 | – | 64.23 | 10.28 | 1.45 | 8.37 | – |
| Carnation Pinks (whole plant),** | 8.80 | 38.07 | 12.84 | 18.64 | 3.98 | .34 | 5.23 | .24 |
| Asparagus stems, | – | 42.94 | 3.58 | 27.18 | 12.77 | 1.22 | 12.31 | .08 |
| Asparagus roots, | – | 56.43 | 5.42 | 15.48 | 7.57 | – | 15.09 | 3.67 |
| Onions, | – | 38.51 | 1.90 | 8.20 | 3.65 | .58 | 15.80 | 3.33 |

* With tendrils and blossoms.

† One year old.

‡ Nitrogen in dry matter, .96 per cent.

§ Wilder.

‖ Downing.

¶ Yellows.

** Nitrogen in dry matter, 1.15 per cent.

## *D. Analyses of Sugar-producing Plants.*

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

| NAME. | Date. | Brix Saccharometer (Degrees). | Per Cent. of Sugar. | Non-saccharine Substances. |
|---|---|---|---|---|
| Electoral, . . . . . | Sept. 10, | 14 | 12.30 | 1.75 |
| Imperial, . . . . . | " 12, | 15 | 12.59 | 2.41 |
| Vilmorin, . . . . . | " 13, | 14.5 | 12.95 | 1.55 |
| Imperial, . . . . . | " 18, | 14 | 10.79 | 3.21 |
| Imperial, . . . . . | Oct. 11, | 15 | 12.05 | 2.95 |
| Electoral, . . . . . | " 16, | 15 | 12.22 | 2.78 |
| Vilmorin, . . . . . | " 18, | 16 | 13.13 | 2.87 |
| Imperial, . . . . . | Nov. 14, | 15 | 11.60 | 3.34 |
| Vilmorin, . . . . . | " 21, | 15.5 | 13.12 | 2.38 |
| Vienna Globe,* . . . . | Sept. 19, | 11 | 8.00 | 3.00 |
| Common Mangold,* . . . | " 19, | 9 | 5.00 | 3.97 |

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

| NAME. | Source of Seed. | Weight in Pounds. | Per Cent. of Sugar in Juice. |
|---|---|---|---|
| I. Vilmorin, . . . . . | Saxony, . | $\frac{3}{4}$ to $\frac{7}{8}$ | 15.50 |
| II. Vilmorin, . . . . . | Saxony, . | $\frac{3}{4}$ to 1 | 15.61 |
| I. White Imperial, . . . . | Saxony, . | $\frac{3}{4}$ to $1\frac{3}{4}$ | 14.20 |
| II. White Imperial, . . . . | Saxony, . | $1\frac{3}{4}$ to 2 | 10.27 |
| New Imperial, . . . . . | Saxony, . | $1\frac{1}{4}$ to $1\frac{3}{4}$ | 13.80 |
| I. White Magdeburg, . . . . | Saxony, . | $1\frac{1}{2}$ to 2 | 13.10 |
| II White Magdeburg, . . . . | Silesia, | $1\frac{1}{2}$ to $1\frac{3}{4}$ | 10.06 |
| Quedlinburg, . . . . . . | Saxony, . | $1\frac{1}{2}$ to $1\frac{3}{4}$ | 13.44 |
| White Silesian, . . . . . | Silesia, . | $1\frac{1}{4}$ to $1\frac{1}{2}$ | 9.72 |

## *D. Analyses of Sugar-producing Plants* — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

| SOIL. | MANURE. | Specific Gravity Brix (Degrees). | Per Cent. of Sugar in Juice. | Non-saccharine Substances. | Cane Sugar in Soluble Matter. |
|---|---|---|---|---|---|
| Sandy loam, | Fresh yard-manure, | 16.5 | 12.50 | 4.00 | 75.08 |
| Clayish loam, | Fresh yard-manure, | 15.5 | 11.05 | 4.45 | 71.30 |
| Warm alluvial, | Yard-manure and chemicals, | 12.75 | 9.17 | 3.58 | 71.92 |
| Warm alluvial, | Fresh hog-manure, | 13.5 | 9.53 | 3.97 | 70.06 |
| Light, sandy soil, | No manure, | 18.5 | 13.73 | 4.77 | 74.21 |
| Alluvial soil, | Brighton fish, | 14.5 | 11.15 | 3.35 | 76.90 |
| Heavy soil, | Yard-manure, | 12.25 | 8.15 | 4.10 | 66.53 |
| – | – | 13.5 | 9.90 | 3.60 | 73.33 |

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* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

| FERTILIZERS. | PERCENTAGES OF SUGAR IN JUICE. | | |
|---|---|---|---|
| | Freeport. | Electoral. | Vilmorin. |
| Fresh horse-manure, | 11.96 | 9.42 | 7.80 |
| Blood guano without potash, | 10.99 | 10.10 | 10.20 |
| Blood guano with potash, | 12.55 | 13.24 | 10.50 |
| Kainite and superphosphate, | 13.15 | 12.16 | 10.50 |
| Sulphate of potash, | 14.52 | 14.32 | 12.78 |
| Second year after stable-manure, | 13.49 | 12.78 | 12.19 |

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* All were grown on the same soil, — sandy loam (college).

## D. *Analyses of Sugar-producing Plants* — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

| Locality of Beet-field. | Date. | Brix Saccharometer (Degrees). | Per Cent. of Cane Sugar. | Non-saccharine Substances. |
|---|---|---|---|---|
| 1. Sing Sing, N. Y., | 1872-73 | 11 | 7.80 | 3.20 |
| 2. Washington, N. Y., | " | 14 | 10.97 | 3.03 |
| 3. South Hartford, N. Y., | " | 15 | 11.70 | 3.30 |
| 4. Greenwich, N. Y., | " | 12 | 9.50 | 2.50 |
| 5. Frankfort, N. Y., | " | 13.5 | 11.00 | 2.50 |
| 6. Albion, N. Y.,* | " | 18 | 15.10 | 2.90 |
| Albion, N. Y.,† | " | 14 | 9.70 | 4.30 |

* From beets weighing from 1½ to 2 pounds. † From beets weighing from 10 to 14 pounds.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

### *Composition of Canada-grown Sugar Beets.*

[1872 and 1873.]

| Where Grown. | Weight of Roots. | Specific Gravity of Juice (Brix). | Temperature of Juice. | Per Cent. of Cane Sugar in Juice. |
|---|---|---|---|---|
| Echaullon de Montreal, | 2 to 2½ lbs | 15.4° | 64° F. | 11.38 |
| Riviere du Loup, | 2 to 3¼ lbs. | 14.5° | 63° F. | 10.20 |
| Chambly, | 2 to 2½ lbs. | 13.2° | 63° F. | 9.02 |
| Maskinonge, | 2 to 3 lbs. | 13.4° | 63° F. | 8.83 |

## *D. Analyses of Sugar-producing Plants* — Continued.

[Early Amber Cane.]

| DATE. | CONDITION OF CANE. | Brix Saccharometer (Degrees). | Temperature C. (Degrees). | Glucose. | Cane Sugar. | Soda solution required to neutralize 100 parts of Juice. | Solids. |
|---|---|---|---|---|---|---|---|
| **1879.** | | | | Per ct. | Per ct. | C. C. | Per ct. |
| Aug. 15, | No flower stalks in sight,* | 4.2 | 27 | 2.48 | None. | 6.8 | 7.93 |
| Aug. 16, | No flower stalks in sight,* | 5.8 | 24 | 4.06 | None. | 9.0 | 11.10 |
| Aug. 20, | Flower stalks developed,* | 7.9 | 24 | 3.47 | 2.15 | 7.0 | 13.00 |
| Aug. 24, | Flowers open,* | 8.7 | 23 | 3.70 | 3.00 | 4.0 | 14.07 |
| Aug. 27, | Plants in full bloom,* | 10.0 | 25 | 3.65 | 4.13 | 10.0 | 15.48 |
| Aug. 30, | Seed forming,* | 9.5 | 30 | 4.00 | 3.81 | 9.5 | 16.14 |
| Sept. 2, | Seed in milk,* | 10.7 | 27 | 3.85 | 4.41 | 9.5 | 15.85 |
| Sept. 9, | Seeds still soft,* | 12.1 | 22 | 3.21 | 6.86 | 9.5 | 26.13 |
| Sept. 9, | Stripped on Sept. 2,* | 12.8 | 22 | 3.77 | 6.81 | 9.5 | 26.75 |
| Sept. 18, | Left on field without stripping,* | 13.2 | 22 | 3.57 | 7.65 | - | - |
| Sept. 18, | Tops removed,* | 13.8 | 22 | 3.16 | 8.49 | - | - |
| Sept. 18, | Tops and leaves removed on Sept. 9,* | 11.5 | 22 | 3.16 | 5.85 | - | - |
| Sept. 18, | Tops removed; left on field 9 days,* | 12.8 | 22 | 10.00 | .60 | - | - |
| Sept. 21, | Juice from the above,* | 13.0 | 21 | - | - | - | - |
| Sept. 23, | Juice from the above,* | 15.0 | 18 | - | - | - | - |
| Sept. 25, | Left on field 3 weeks,† | 19.8 | 21 | 11.91 | 6.27 | - | - |
| Sept. 28, | Left on field 3 weeks,† | 17.8 | 12 | 16.60 | - | - | - |
| Oct. 4, | Left on field 3 weeks,† | 16.1 | 17 | 8.62 | 6.16 | 12.0 | - |
| Oct. 7, | Freshly cut. Ground with leaves,† | 16.7 | 20 | 4.16 | 9.94 | 6.8 | - |
| Oct. 8, | Freshly cut. Stripped two weeks,† | 12.8 | 17 | 5.16 | 5.27 | 7.0 | - |
| Oct. 9, | Freshly cut. Stripped two weeks,† | 18.4 | 17 | 7.57 | - | 10.6 | - |
| Oct. 14, | Several weeks old,† | 18.2 | 15 | 10.42 | - | 10.4 | - |
| Oct. 18, | Several weeks old,† | 15.1 | 23 | 7.57 | - | - | - |
| Oct. 19, | Several weeks old,† | 15.5 | 15 | 9.22 | - | 13.6 | - |
| Oct. 22, | Several weeks old,† | 16.2 | 16 | 8.30 | - | - | - |
| Oct. 23, | Several weeks old,† | 18.3 | 17 | 11.30 | 5.5 | 14.0 | - |
| Oct. 24, | Several weeks old,† | 16.6 | 15 | 8.63 | - | 9.0 | - |

| | | 100 PARTS OF CANE CONTAINED — | | | | |
|---|---|---|---|---|---|---|
| | | Moisture. | Glucose. | Cane Sugar. | Total Sugar. | |
| **1889.** | | | | | | |
| October, | Early Tennessee sorghum, mature, | 77.43 | 1.79 | 3.21 | 5.00 | Grown on station grounds. |
| October, | Price's new hybrid, ripe, | 77.80 | 2.92 | 3.78 | 6.70 | |
| October, | Kansas orange, green, | 80.67 | 2.38 | 3.63 | 6.01 | |
| October, | New orange, green, | 78.30 | 2.96 | 3.85 | 6.81 | |
| October, | Honduras, green, | 77.55 | 3.08 | 4.01 | 7.09 | |

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

## D. *Analyses of Sugar-producing Plants* — Concluded.

[Composition of the juice of corn stalks and melons.]

| VARIETY. | Specific Gravity. | Temperature C. (Degrees). | Glucose. | Cane Sugar in Juice. | Solids. |
|---|---|---|---|---|---|
| | | | Per ct. | Per ct. | Per ct. |
| Northern corn,* . . . . . | 1.023 | 27 | 4.35 | 0.28 | 15.18 |
| Black Mexican sweet corn,† . . | 1.048 | 27 | 2.06 | 7.02 | 17.44 |
| Evergreen sweet corn,† . . . | 1.052 | – | 4.85 | 5.70 | 20.38 |
| Common sweet corn,‡ . . . | 1.035 | – | 6.60 | None. | – |
| Common yellow musk-melon,§ . | 1.040 | 26 | 1.67 | 2.65 | – |
| White-flesh water-melon, . . | 1.025 | 18 | 2.91 | 2.16 | – |
| Red-flesh water-melon, . . . | 1.025 | 22 | 3.57 | 2.18 | – |
| Red-flesh water-melon, . . . | 1.025 | 19 | 3.84 | 1.77 | – |
| Nutmeg musk-melon,‖ . . . | 1.030 | 19 | 3.33 | 2.11 | – |
| Nutmeg musk-melon,¶ . . . | 1.050 | 20 | 2.27 | 5.38 | – |
| Nutmeg musk-melon,** . . | 1.030 | 19 | 2.50 | 1.43 | – |

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

## E. *Analyses of Dairy Products.*

| | Analyses. | Solids. | | | Fat. | | | Curd. | | | Salt. | | | Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | |
| Whole milk, | 1,738 | 18.27 | 10.58 | 13.49 | 7.54 | 1.72 | 4.14 | - | - | 3.20 | - | - | - | .70 |
| Skim-milk, | 328 | 10.40 | 7.68 | 9.48 | 1.02 | .05 | .39 | - | - | 3.53 | - | - | - | .80 |
| Buttermilk, | 31 | 9.86 | 6.83 | 8.33 | .38 | .11 | .27 | - | - | 2.79 | - | - | - | .80 |
| Cream (from Cooley Creamer), | 176 | 32.78 | 19.93 | 26.47 | 25.00 | 13.11 | 17.98 | - | - | - | - | - | - | .62 |
| Butter, | 25 | 92.89 | 87.05 | 89.11 | 89.05 | 81.43 | 83.95 | .89 | .51 | .66 | 6.45 | 3.46 | 4.74 | - |
| Whole-milk cheese (Jersey),* | 1 | - | - | 62.84 | - | - | 37.32 | - | - | 22.13 | - | - | - | 3.39 |
| Whole-milk cheese,* | 1 | - | - | 64.17 | - | - | 34.34 | - | - | 26.69 | - | - | - | 3.14 |
| Cheese from milk skimmed after twelve hours' standing,* | 1 | - | - | 62.70 | - | - | 27.81 | - | - | 30.37 | - | - | - | 4.52 |
| Cheese from milk skimmed after twenty-four hours' standing,* | 1 | - | - | 57.76 | - | - | 23.42 | - | - | 31.99 | - | - | - | 2.35 |
| Cheese from milk skimmed after thirty-six hours' standing,* | 1 | - | - | 56.05 | - | - | 17.67 | - | - | 33.24 | - | - | - | 5.14 |
| Cheese from milk skimmed after forty-eight hours' standing,* | 1 | - | - | 54.59 | - | - | 15.77 | - | - | 34.94 | - | - | - | 3.88 |
| Cheese from skim-milk, with addition of buttermilk,* | 1 | - | - | 51.62 | - | - | 18.35 | - | - | 28.63 | - | - | - | 4.64 |
| Genuine oleomargarine cheese,* | 1 | - | - | 62.10 | - | - | 31.66 | - | - | 25.94 | - | - | - | 4.50 |

* From analyses made in 1875.

## E. *Salt for Meat Packing and Dairy Purposes.*

| KIND AND SOURCE. | Moisture, 100° C. | Sodium Chloride. | Calcium Sulphate. | Calcium Chloride. | Magnesium Chloride. | Sodium Sulphate. | Magnesium Sulphate. | Insoluble Matter. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| Rock salt of Pettite Anse, La., | .330 | 98.882 | .782 | .004 | .003 | – | – | – | Sent on for examination. |
| Rock salt of Neyba, San Domingo, W. I., | .300 | 98.330 | 1.480 | – | .090 | .070 | .070 | – | |
| Solar salt, Onondaga, N. Y., | 2.500 | 96.004 | 1.315 | .092 | .089 | – | – | – | |
| Solar salt, Hocking Valley, O., | 2.130 | 97.512 | None. | .234 | .089 | – | – | – | |
| Solar salt, Saginaw Valley, Mich., | 3.344 | 95.813 | .316 | .356 | .140 | – | – | – | |
| Solar salt from Kansas, | 4.950 | 93.060 | 1.220 | – | .240 | .350 | .180 | – | |
| Solar salt, Lincoln County, Neb., | 1.200 | 98.130 | .250 | – | .080 | .390 | None. | – | |
| Common fine and boiled salt, Onondaga, N. Y., | 3.000 | 95.353 | 1.355 | .155 | .136 | – | – | – | |
| Common fine and boiled salt, Portsmouth, Mich., | 6.752 | 90.682 | .805 | .974 | .781 | – | – | – | |
| Common fine and boiled salt, Mason City, O., | 3.470 | 95.789 | – | .614 | .041 | – | – | – | |
| Dairy and table salt, Ashton's (English), | 0.760 | 97.652 | 1.430 | – | .060 | – | .048 | .050 | |
| Onondaga dairy salt, | 0.700 | 97.832 | 1.263 | – | .037 | .026 | .023 | .120 | |
| Fine salt, Bulletin 26, I., | 3.280 | 95.091 | 1.487 | .032 | .075 | – | – | .035 | |
| Fine salt, Bulletin 26, II., | 4.591 | 94.012 | 1.177 | .143 | .049 | – | – | .028 | |
| Fine salt, Bulletin 26, III., | 4.616 | 94.236 | .999 | .071 | .026 | – | – | .052 | Salicylic acid: trace. |
| Dairy salt, sent on from Amherst, Mass., | 0.145 | 98.520 | 1.009 | .189 | .065 | – | – | .072 | |
| Ashton salt (sent on), | .760 | 97.650 | 1.430 | – | .060 | – | .050 | .050 | |
| Onondaga factory-filled (sent on), | .600 | 98.280 | .910 | – | – | .030 | .060 | .120 | |
| Dairy salt, sent on from Amherst, | .505 | 98.202 | .877 | .168 | .046 | – | – | .202 | |
| Rock salt from Retsof salt mines, | 2.600 | 95.940 | .420 | .330 | .010 | – | – | .700 | |
| Royal salt, | .880 | 97.877 | 1.108 | .016 | .010 | – | – | .102 | |
| Excelsior salt, | .320 | 98.009 | 1.644 | .013 | .014 | – | – | .020 | |
| Genesee salt, | .295 | 98.513 | 1.160 | .010 | .012 | – | – | .010 | |
| Genesee salt, | .235 | 98.563 | 1.137 | .045 | .020 | – | – | – | |
| Bradley salt, | .200 | 98.575 | 1.185 | .029 | .007 | – | – | – | |
| Higgins' Eureka salt, | .855 | 98.891 | .906 | .293 | .055 | – | – | – | |
| Worcester refined salt, | .565 | 97.935 | 1.376 | .097 | .027 | – | – | – | |

*F. Analyses of Insecticides.*

| | Moisture. | Arsenious Oxide. | Copper Oxide. | Acetic Acid. | Nicotine. | Mercury. | Sulphur. | Sulphuric Acid. | Chlorine. | Calcium Oxide. | Potassium Oxide. | Ferric and Aluminic Oxides. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paris green, | 1.30 | 62.55 | 32.84 | 3.10 | - | - | - | - | - | - | - | - | 0.21 |
| Paris green, | 1.41 | 61.40 | 33.20 | 3.90 | - | - | - | - | - | - | - | - | 0.09 |
| Paris green, | 1.40 | 61.15 | 33.10 | 3.71 | - | - | - | - | - | - | - | - | 0.64 |
| Paris green, | 1.15 | 53.91 | 31.27 | 8.10 | - | - | - | - | - | - | - | - | 0.04 |
| Paris green, | 1.34 | 61.25 | 33.35 | 3.93 | - | - | - | - | - | - | - | - | 0.13 |
| Paris green, | 1.31 | 61.21 | 33.45 | 3.94 | - | - | - | - | - | - | - | - | 0.09 |
| Paris green, | 1.15 | 59.92 | 30.40 | - | - | - | - | - | - | - | - | - | 0.10 |
| Paris green, | 1.27 | 54.80 | 30.85 | 6.50 | - | - | - | - | - | - | - | - | 0.12 |
| "Sulphatine," | 1.40 | - | 2.61 | - | - | - | 48.28 | 4.73 | - | 18.60 | - | - | 1.63 |
| "Death to Rose Bugs," | 2.95 | - | 1.05 | - | - | - | 34.53 | 4.35 | - | 17.76 | - | - | 0.49 |
| "Professor De Graff's Carpet Bug Destroyer," | 95.81 | - | - | - | - | 0.78 | - | 0.48 | 0.27 | - | 0.26 | 0.90 | - |
| "Oriental Fertilizer and Bug Destroyer," | 87.14 | 2.38 | - | - | - | - | - | .64 | 3.00 | - | 3.50 | - | - |
| "Non-poisonous Potato Bug Destroyer," | - | - | - | - | - | - | - | - | - | 68.20 | - | 1.38 | 1.50 |
| Tobacco liquor, | 37.71 | - | - | - | 2.12 | - | - | - | - | 3.07 | 6.55 | 0.23 | - |
| Tobacco liquor, | 40.89 | - | - | - | 0.53 | - | - | - | - | 1.47 | 16.34 | 0.01 | - |
| Tobacco liquor, | - | - | - | - | 4.55 | - | - | - | - | - | - | - | - |
| Tobacco liquor, | - | - | - | - | 4.82 | - | - | - | - | - | - | - | - |
| "Nicotinia," | 10.00 | - | - | - | - | - | - | - | - | 4.45 | 9.15 | - | 2.12 |
| Hellebore, | - | - | - | - | - | - | - | - | - | - | - | - | 2.34 |
| Hellebore, | - | - | - | - | - | - | - | - | - | - | - | - | 38.12 |
| "Peroxide of Silicate," | 1.65 | 0.57 | 0.33 | - | - | - | - | 49.66 | - | 41.18 | - | - | 2.31 |

# VI. TABLES OF THE DIGESTIBILITY OF AMERICAN FEED-STUFFS.

## EXPERIMENTS MADE IN THE UNITED STATES.

COMPILED BY J. B. LINDSEY.

I. EXPERIMENTS WITH RUMINANTS.

II. EXPERIMENTS WITH SWINE

DEC. 31, 1893.

## TABLE OF THE DIGESTIBILITY OF AMERICAN FEED STUFFS.

### I. EXPERIMENTS WITH RUMINANTS.

| KIND OF FODDER. | Number of Different Samples. | Number of Experiments. | Number of Animals. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|---|---|---|---|
| *Hay and Dry Coarse Fodders.* | | | | | | | | | |
| Timothy hay, in bloom, | 7 | 8 | 13 | 55.6—65.7<br>60 | 56.1—66.8<br>60 | 49.6—62.1<br>56 | 42.8—75.9<br>57 | 40.9—60.4<br>48.5 | 58—71.8<br>65 |
| Timothy hay, past bloom, | 4 | 4 | 8 | 47—61.1<br>53 | 50.4—62.3<br>54.5 | 37.2—56.8<br>47 | 54.5—61.1<br>52 | 38.8—50.4<br>45 | 57.7—67<br>60 |
| Hay of mixed grasses, poor in nitrogen, | 1 | 1 | 2 | – | – | 49 | 50 | 40 | 58 |
| Hay of mixed grasses, rich in nitrogen,* | 2 | 2 | 7 | 55.10—62<br>58 | –<br>– | 55.90—65.86<br>60 | 45.65—57.04<br>49 | 56.08—63.76<br>60 | 56.80—63.46<br>60 |
| Clover and timothy hay poorly cured, | 1 | 1 | 2 | 54.3—55.3<br>55 | –<br>– | 52—54.4<br>53 | –<br>58 | 37.5—37.9<br>38 | –<br>60 |
| Hungarian hay, | 1 | 1 | 2 | 64.3—65.8<br>65 | 65.9—66.8<br>66 | 66.8—68.5<br>68 | –<br>64 | –<br>60 | 66.9—67.4<br>67 |
| Cow-pea-vine hay, fair quality, | 1 | 1 | 2 | –<br>59 | –<br>– | 41.2—44.6<br>43 | 46.4—53.7<br>50 | 63.9—65.1<br>65 | –<br>71 |
| Clover hay, late bloom, fair quality, | 1 | 1 | 2 | 54.4—55.5<br>55 | 55.9—56.4<br>56 | 43.8—49<br>46 | 51.8—54.8<br>53 | 49.3—59.1<br>55 | 63.3—64.8<br>64 |
| Clover hay, good quality, | 1 | 2 | 2 | 50.8—53.5<br>52 | 51.6—54.3<br>53 | 46.6—49<br>48 | 40—48<br>43 | 47—52.2<br>49 | 56.8—58.9<br>58 |
| White clover hay, bloom, | 1 | 1 | 2 | 66 | 67 | 61 | 51 | 73 | 70 |
| Scarlet clover hay (*T. incarnatum*), | 1 | 1 | 2 | 59.4—65<br>62 | –<br>– | 42.6—54.8<br>49 | 43.7—54<br>49 | 68.5—69.7<br>69 | 69.3—73.6<br>72 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Alsike clover (*T. hybridum*), | 2 | 2 | 4 | 61.1—64.3<br>62 | 62—65.2<br>63 | 51—58.7<br>53 | 35.1—69.3<br>50 | 64—69.2<br>66 | 66.5—74.1<br>71 |
| Alfalfa (lucerne), late bloom, | 1 | 1 | 2 | - | - | 49 | 54 | 77 | 64 |
| Alfalfa (lucerne), stage not given, | 1 | 1 | 1 | - | - | 43 | 48 | 69 | 72 |
| Alfalfa, average both samples, | 2 | 2 | 3 | - | - | 46 | 51 | 73 | 68 |
| Hay of blue-joint grass, past bloom, | 1 | 1 | 2 | 40 | 42 | 37 | 37 | 57 | 43 |
| Hay of blue-joint grass, bloom, | 1 | 1 | 2 | 66.7—70.5<br>69 | 68.1—71.5<br>70 | 71.5—73.4<br>72 | 51.4—53.3<br>52 | 68.2—72.3<br>70 | 66.4—70.9<br>69 |
| Hay of orchard grass, ten days after bloom, | 1 | 1 | 2 | 54 | 56 | 58 | 54 | 59 | 54 |
| Hay of orchard grass, stage not given, | 1 | 1 | 2 | 57.5—60<br>59 | -<br>- | 60—66.7<br>64 | 55.4—57.4<br>56 | 60—60.8<br>60 | 55.3—57.3<br>56 |
| Average of both samples, | 2 | 2 | 4 | 56 | 56 | 61 | 55 | 60 | 55 |
| Hay of red top, | 2 | 2 | 4 | 57.6—62.3<br>60 | 59.3—63.6<br>61 | 60.8—61.8<br>61 | 44.2—58.8<br>51 | 60.4—62.4<br>61 | 59.1—65.2<br>62 |
| Hay of wild oat grass (*Danthonica spicata*), | 2 | 2 | 3 | 59.6—68.3<br>64 | 61.2—69.1<br>65 | 65.1—70.6<br>68 | 38.2—62.8<br>50 | 48.6—68<br>58 | 62.1—68.8<br>65 |
| Hay of witch grass (*Triticum repens*), | 2 | 2 | 4 | 59.9—62.7<br>61 | 61—64.3<br>62 | 56.4—67.6<br>62 | 53.6—60<br>57 | 49.5—64.2<br>58 | 62.1—69.9<br>66 |
| Hay of buttercups (*Ranunculus acris*), | 1 | 1 | 2 | 56 | 57 | 41 | 70 | 56 | 67 |
| Hay of white weed (*Leucanthemum vulgare*), | 1 | 1 | 2 | 58 | 58 | 46 | 62 | 58 | 67 |
| Soja-bean hay, low in nitrogen, | 1 | 1 | 2 | - | - | 58 | 54 | 70 | 82 |
| Dried pasture grass, | 1 | 1 | 1 | 71 | - | 77 | 60 | 72 | 73 |
| Oat straw, | 1 | 1 | 2 | 49—51.7<br>50 | 50.8—53.2<br>52 | 57.2—58<br>58 | 35.5—41<br>38 | -<br>- | 51.8—54.6<br>53 |

* Above ten per cent. protein.

## *Table of the Digestibility of American Feed Stuffs* — Continued.

| KIND OF FODDER. | Number of Different Samples. | Number of Experiments. | Number of Animals. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent ). |
|---|---|---|---|---|---|---|---|---|---|
| *Hay and Dry Coarse Fodders* — Concluded. | | | | | | | | | |
| Cotton-seed hulls, | 3 | 3 | 9 | 35—47.5<br>41 | -<br>- | 0.54—57.6<br>47 | 58.2—89.3<br>79 | .00—24.6<br>6 | 12.9—45.7<br>34 |
| Raw cotton seed, | 1 | 2 | 1 | 62.9—69.3<br>66 | -<br>- | 65—85.9<br>76 | -<br>87 | 65.7—70<br>68 | 49.2—50<br>50 |
| Roasted cotton seed, | 1 | 1 | 2 | 53.5—58.4<br>56 | -<br>- | 62.5—69.3<br>66 | 68.5—75<br>72 | 44.3—49.6<br>47 | 49.8—53<br>51 |
| Corn stover, whole plant, | 1 | 2 | 2 | 61.1—62<br>62 | -<br>- | 64.8—68.3<br>67 | 48.1—55.8<br>52 | 49.6—54.8<br>52 | 62.5—64.5<br>64 |
| Corn stover, tops and blades, | 1 | 1 | 2 | 59—60.5<br>60 | -<br>- | 71.1—71.7<br>71 | 70.6—71.9<br>71 | 54.2—56.6<br>55 | 61.9—62.6<br>62 |
| Pulled stover, leaves, | 1 | 1 | 2 | 54.8—56.2<br>56 | -<br>- | 54.3—67<br>61 | 60.6—65.4<br>63 | 43.15—68.76<br>56 | 57.1—60.65<br>59 |
| Field corn fodder, ears glazing or glazed, | 5 | 5 | 10 | 58.8—71.8<br>67 | -<br>- | 53.4—80<br>70 | 66.7—79<br>73 | 44—64.6<br>53 | 61—73.4<br>68 |
| Field corn fodder, ears glazed, very coarse (sheep), | 1 | 1 | 2 | 57.6—63.9<br>61 | -<br>- | 66.7—74.3<br>71 | 65.6—84.2<br>75 | 22.4—35.9<br>29 | 59.9—65.5<br>63 |
| Southern corn fodder, no ears formed, | 2 | 2 | 4 | 63.6—70.3<br>67 | 65.3—71.4<br>69 | 71.7—77.5<br>74 | 68.1—72.3<br>70 | 57.2—66.1<br>62 | 62.8—70.4<br>67 |
| Corn stalks, below ear,* | 1 | 1 | 2 | 64—69<br>67 | -<br>- | 71—75<br>74 | 79—80<br>80 | 15—27<br>21 | 65—73<br>69 |
| Topped stover, part above ear,* | 1 | 1 | 2 | 52—58<br>55 | -<br>- | 69—72<br>71 | 62—65<br>64 | 17—27<br>22 | 50—57<br>54 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Corn husks,* | 1 | 1 | 2 | 71—73<br>72 | -<br>- | 78—81<br>80 | 23—42<br>33 | 24—35<br>30 | 75<br>- |
| Corn leaves, below ear,* | 1 | 1 | 2 | 62—67<br>65 | -<br>- | 75—80<br>78 | 52—59<br>56 | 28—41<br>35 | 66—70<br>68 |
| *Green Fodders.* | | | | | | | | | |
| Corn fodder, quite young, | 1 | 1 | 2 | 67.2—70.2<br>69 | -<br>- | 73.8—75.6<br>75 | 37.5—42.5<br>40 | 76.4—79.9<br>78 | 64—67.7<br>66 |
| Dent corn fodder, ears not begun to form, thick seeded, | 1 | 1 | 2 | 71.3—73.7<br>72 | -<br>- | 70.8—72.<br>71 | 76.1—81.6<br>79 | 72.5—75.2<br>74 | 74.6—75.3<br>75 |
| Dent corn fodder, ears well formed, thick seeded, | 1 | 2 | 2 | 70.9—73.4<br>72 | -<br>- | 64.8—68.<br>66 | 81.2—83.8<br>83 | 56.3—63.7<br>60 | 76.7—78.8<br>78 |
| Dent corn fodder, ears just forming, thin seeded, | 1 | 2 | 2 | 67.2—68<br>68 | -<br>- | 60—61.4<br>61 | 71.6—73.3<br>73 | 55.9—56.8<br>56 | 74<br>- |
| Corn fodder, ears glazing (Burrill & Whitman coarse), | 1 | 1 | 2 | 50.88—53.66<br>52 | -<br>- | 45.5—46.6<br>46 | 74—82<br>78 | 20.13—28.14<br>24 | 57—61.4<br>59 |
| Sweet corn fodder, ears in milk, | 1 | 1 | 2 | 76.5—78<br>77 | -<br>- | 74.2—75.5<br>75 | 73.4—74.4<br>74 | 77.3—77.6<br>77 | 79.6—81.4<br>81 |
| Sweet corn fodder, ears in milk, partially dry, | 2 | 2 | 4 | 60.1—70.2<br>65 | 62.4—73.9<br>68 | 69.5—76.9<br>73 | 66.9—71.3<br>72 | 54.6—63.5<br>61 | 57.4—72.5<br>66 |
| Average of three samples, | 3 | 3 | 6 | 71 | - | 74 | 73 | 69 | 73 |
| Early amber sorghum, just after blossom, | 1 | 2 | 2 | 60.9—61.7<br>61 | -<br>- | 41.7—45.3<br>42 | 67<br>- | 37.7—42.5<br>40 | 70.4—70.8<br>71 |
| Sorghum in blossom, variety not stated, | 1 | 1 | 2 | 73.1—73.3<br>73 | -<br>- | 74—75<br>75 | 81.3—81.6<br>81 | 51.1—55.7<br>53 | 78.2—78.7<br>78 |
| Average both samples, | 2 | 3 | 4 | 67 | - | 59 | 74 | 46 | 74 |

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* Made at Maryland Experiment Station. It will be noticed that the coefficients of protein digestibility are very much below those obtained in other experiments. The animals were fed but six pounds each per day, with no other food, and it is probable that the metabolic nitrogen products excreted were in a measure at least the cause of the low results obtained.

## *Table of the Digestibility of American Feed Stuffs* — Continued.

| KIND OF FODDER. | Number of Different Samples. | Number of Experiments. | Number of Animals. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|---|---|---|---|
| *Green Fodders* — Concluded. | | | | | | | | | |
| Field corn ensilage, ears glazing, | 8 | 9 | 16 | 51.5—69.9<br>62 | 62—69.9<br>65 | 43—77.8<br>63 | 66—90<br>80 | 21—57.6<br>43 | 52.6—75.6<br>68 |
| Fine crushed silage (steers), | 1 | 1 | 2 | 60.4—68<br>64 | –<br>– | 71.6—77.6<br>75 | 74.7—76.6<br>76 | 32.4—44<br>38 | 59.8—69.7<br>65 |
| Fine crushed silage (sheep), | 1 | 1 | 2 | 51.5—56<br>54 | –<br>– | 59.5—67.7<br>64 | 67.5—69<br>68 | 21—22<br>21.5 | 52.6—57.3<br>55 |
| Corn silage, raw, ears mature, | 1 | 1 | 1 | – | – | 59 | 86 | 45 | 71 |
| Same, cooked, | 1 | 1 | 1 | – | – | 70 | 87 | 39 | 75 |
| Sweet corn ensilage, occasional ears mature, | 1 | 1 | 2 | 66.6—69.6<br>68 | 68.5—71.7<br>70 | 68.4—73.7<br>71 | 82.3—84.6<br>83 | 52.7—55.2<br>54 | 70.7—73<br>72 |
| Southern corn ensilage, ears not formed, | 1 | 1 | 2 | 60.6—65.9<br>63 | 63.8—68.7<br>66 | 71.4—76.2<br>74 | 64.3—66.2<br>65 | 42—51.3<br>47 | 63.3—67.9<br>66 |
| Soja-bean ensilage, | 1 | 1 | 2 | 52.2—65.8<br>59 | –<br>– | 47.1—62.5<br>55 | 66.4—77.3<br>72 | 71.3—80.2<br>76 | 45.9—58.2<br>52 |
| Green grass, young, | 1 | 1 | 1 | 69 | – | 74 | 55 | 65 | 72 |
| Same, dry, | 1 | 1 | 1 | 71 | – | 77 | 60 | 71 | 73 |
| Pasture grass, | 1 | 1 | 2 | 71.9—75.6<br>74 | –<br>– | 74.6—76.5<br>76 | 74—74.9<br>74 | 74—76.5<br>75 | 73.8—77.1<br>75 |
| Average of three samples, | – | – | – | 71 | – | 76 | 63 | 70 | 73 |
| Soiling rye, formation of head, | 1 | 1 | 2 | 73.2—74<br>74 | –<br>– | 78.9—80.4<br>80 | 73.6—74.8<br>74 | 78.6—79.7<br>79 | 69.7—71.4<br>71 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Soiling clover, late blossom, | 1 | 1 | 2 | 64.9—67.3<br>66 | -<br>- | 52.3—52.9<br>53 | 63—66.1<br>65 | 65.8—68.3<br>67 | 76.1—79.3<br>78 |
| Hungarian grass, probably in bloom, | 1 | 1 | 4 | 61—67<br>63 | 63.4—68.8<br>66 | 65.4—71.7<br>68 | 47.8—56<br>52 | 59.4—66.4<br>62 | 63.5—68.4<br>66 |
| *Roots, Tubers, etc.* | | | | | | | | | |
| Potatoes, | 1 | 1 | 2 | 73.3—80.1<br>77 | 74.6—81.2<br>78 | -<br>- | 13<br>- | 43.4—45.4<br>44 | 87.3—93.4<br>91 |
| Sugar beets, | 1 | 1 | 2 | 94.2—94.8<br>95 | 97.6—99.9<br>99 | 88.5—113<br>100 | 46.4—53.5<br>50 | 90—92.6<br>91 | 99.8—100<br>100 |
| Mangolds, | 1 | 1 | 2 | 77.1—80<br>79 | 82.7—87<br>85 | 26.8—58.8<br>43 | -<br>- | 69.7—79.8<br>75 | 90.8—91.9<br>91 |
| English flat turnips, | 1 | 1 | 2 | 90.7—94.9<br>93 | 93.2—99<br>96 | 89.2—117<br>100 | 82.5—92.5<br>98 | 84.5—95<br>90 | 96—97<br>97 |
| Ruta-bagas, | 1 | 1 | 2 | 84.4—90<br>87 | 89.2—93<br>91 | 61—87.5<br>74 | 76.8—91.6<br>84.2 | 74.7—85.9<br>80.3 | 94.4—95.1<br>95 |
| *Grains.* | | | | | | | | | |
| Corn meal, maize, | 1 | 1 | 2 | 82.5—86.7<br>85 | -<br>- | -<br>- | 87—96.9<br>92 | 56.9—59.6<br>58 | 85.2—89.1<br>87 |
| Pea meal, | 1 | 1 | 2 | 85.1—88.5<br>87 | 86.4—89.5<br>88 | 25.5—26<br>26 | 52.1—56.9<br>55 | 80.5—85.9<br>83 | 92.8—94.5<br>94 |
| *By-products.* | | | | | | | | | |
| Cotton-seed meal, | 1 | 1 | 2 | 80.8—82.2<br>82 | 80.3—81.8<br>81 | -<br>- | 100<br>- | 88.2—89.4<br>89 | 67.3—70.4<br>69 |
| Gluten meal, | 1 | 1 | 2 | 84.7—90.2<br>87 | 86.3—91.9<br>89 | 33<br>- | 85.6—90.1<br>88 | 83—90.2<br>87 | 88.2—93.5<br>91 |
| Wheat bran, | 4 | 4 | 7 | 54.4—66.45<br>61 | 59.5—68.5<br>63 | 20—56.28<br>25 | 59.5—84.5<br>72 | 70.1—82.7<br>78 | 58.6—71.22<br>68 |

*Table of the Digestibility of American Feed Stuffs* — Concluded.

| KIND OF FODDER. | Number of Different Samples. | Number of Experiments. | Number of Animals. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Crude Cellulose (Per Cent.). | Crude Fat (Per Cent.). | Crude Protein (Per Cent.). | Extract Matter (Per Cent.). |
|---|---|---|---|---|---|---|---|---|---|
| *By-products* — Concluded. | | | | | | | | | |
| Wheat middlings,* | 1 | 1 | 2 | 72.6—72.2<br>75 | 75.1—79.3<br>77 | -<br>- | 84.1—86.1<br>85 | 78.4—79.4<br>79 | 80.7—84.5<br>83 |
| Wheat middlings,† | 1 | 1 | 2 | 79.48—85.63<br>83 | -<br>- | 32.57—40.06<br>36 | 81.71—87.98<br>85 | 81.83—87.75<br>85 | 84.43—91.08<br>88 |
| Malt sprouts, | 1 | 1 | 1 | 67 | 68 | 34 | 100 | 80 | 69 |
| Buffalo Gluten feed, | 1 | 1 | 2 | 75.53—80.44<br>78 | -<br>- | 39.92—46.28<br>43 | 80.58—82.25<br>81 | 83.94—85.97<br>85 | 78.44—84.37<br>81 |
| New-process linseed meal, | 1 | 1 | 2 | 79.86—82.60<br>81 | -<br>- | 49.24—73.21<br>61 | 90.50—91.52<br>91 | 86.32—88.16<br>87 | 84.71—86.31<br>86 |
| Old-process linseed meal, | 1 | 1 | 3 | 75.48—82.25<br>79 | -<br>- | 37.80—71.47<br>57 | 85.3 —92.01<br>89 | 86.38—93.38<br>89 | 75.58—78.73<br>78 |
| Corn cobs, | 1 | 1 | 2 | 58.51—60.43<br>59 | -<br>- | 64.50—66.15<br>65 | 44.22—56.00<br>50 | 12.89—21.88<br>17 | 59.71—60.37<br>60 |
| Dried brewers' grains, | 1 | 1 | 2 | 61.63—61.68<br>62 | -<br>- | 50.04—55.11<br>53 | 89.43—92.79<br>91 | 77.71—80.82<br>79 | 58.70—58.96<br>59 |
| Spring wheat bran, | 1 | 1 | 2 | 62.26—62.80<br>63 | -<br>- | 22.18—25<br>24 | 75.53—75.67<br>76 | 77.68—81.59<br>80 | 69.55—71.22<br>70 |
| Winter wheat bran, | 1 | 1 | 1 | 66 | - | 56 | 61 | 79 | 70 |

## II. — EXPERIMENTS WITH SWINE.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Maize kernels, whole, | 1 | 1 | 1 | 83 | 83 | 38 | 46 | 69 | 89 |
| Maize meal, | 2 | 2 | 2 | 89.5—89.7<br>90 | 91.3—92.1<br>92 | 29.4—48.7<br>39 | 77.6—81.7<br>80 | 86.1—89.9<br>88 | 93.9—94.2<br>94 |
| Maize meal, with cobs, | 1 | 1 | 1 | 76 | 77 | 29 | 82 | 76 | 84 |
| Pea meal, | 1 | 1 | 1 | 90 | 92 | 78 | 50 | 89 | 95 |
| Barley meal, | 1 | 1 | 1 | 80 | 80 | 49 | 57 | 81 | 87 |
| Wheat shorts, | 1 | 2 | 2 | 74—79<br>77 | –<br>– | 25—48<br>37 | –<br>– | 71—75<br>73 | 85.5—88<br>87 |
| Wheat bran, | 1 | 2 | 2 | 53.7—68.6<br>61 | –<br>– | 29.6—39.1<br>34 | 65.4—78.1<br>72 | 74.4—75.8<br>75 | 56—75<br>66 |

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* Jordan.

† Very fine and quite light in color. Lindsey.

## Remarks on the Above Tables of Digestibility.

The various reports and bulletins published by the different experiment stations in the United States have been examined, and results of the digestion experiments reported carefully tabulated. It is believed that in many cases these figures can be taken as a very fair representation of the digestibility of American feed stuffs. The writer recognizes the great amount of work done by German investigators in this line, and believes further that in many cases it would not be advisable to repeat this work. It has been suggested, for example, that our climatic conditions being to a considerable degree different from those prevailing in Germany, such influences would cause a considerable difference in the composition and digestibility of many of our fodder articles. It must not be lost sight of, however, that our own country possesses very much wider ranges of climate than are to be found in the entire German empire; and, if climatic influences do cause noticeable variations, then a wider variation would exist between the grass grown in Maine and in North Carolina than between that grown in Hohenheim and Munich. There are, however, many coarse fodder articles and by-products peculiar to the United States which are well worthy of study, and upon which considerable work needs to be done.

It can be stated that in the digestion experiments here tabulated the coarse fodders have with few exceptions been fed alone, while in the case of grains, by-products and roots, the digestibility of hay has first been determined, and then a certain portion of the hay replaced by roots or grains.

# LITERATURE.

The following publications have been consulted in compiling the tables of the digestibility of American feed stuffs: —

Reports of the Maine State Experiment Station for 1886, 1887, 1888, 1889, 1890, 1891.

Reports of the New York Experiment Station, 1884, 1888, 1889.

Reports of the Pennsylvania Experiment Station, 1887, 1888, 1889, 1890.

Bulletins 87*d*, 80*c* and 81 of the North Carolina Experiment Station.

Bulletin No. 3 of the Wisconsin Experiment Station for 1884, and Sixth Annual Report, 1889.

Bulletin No. 8 of the Colorado Experiment Station.

Bulletin No. 26 of the Minnesota Experiment Station.

Bulletin No. 6 of the Oregon Experiment Station.

Bulletins Nos. 13, 15 and 19 of the Texas Experiment Station.

Bulletin No. 20 of the Maryland Experiment Station.

Eleventh Annual Report (1893) of the Massachusetts State Experiment Station.

# METEOROLOGY.

C. H. JOHNSON.

## 1893.

The meteorological observations have been continued as in previous years. The temperature, the force and the direction of the wind and the amount of cloudiness are recorded each day, at 7 A.M., 2 P.M. and 9 P.M. During the summer months the reading of a wet-bulb thermometer takes place at the same time. Records are also taken of maximum and minimum temperatures, rainfall, and of casual meteorological phenomena.

Monthly and annual reports are sent to the headquarters of the New England Weather Service at Boston, and during the summer months partial monthly reports have been furnished for the use of the secretary of the State Board of Agriculture.

The most conspicuous meteorological phenomena of the past year (1893) will be briefly considered here, while the following tables will show the average monthly temperature, precipitation, prevailing direction of the wind, etc.

The winter of 1893 was exceptionally cold, the mean temperature of January, February and March being 21.88°.

There was no snow on the ground at the beginning of the year, the first fall worthy of mention occurring on January 10, giving 5.5 inches. The heaviest snowfall of the year was on February 22, amounting to 17 inches. The total amount of snow falling during the season was 71.25 inches. As the weather remained cold, the amount of snow after the first fall did not decrease very much, and the ground was protected until the heavy rains of the 12th and 15th of March.

The mean temperature for January was 14.39°, it being the coldest month since January, 1888, when the mean was 12.5°, as recorded at this station. The mean temperature from the 4th to the 24th of January, 1893, was 8.23°, the absolute minimum temperature during that time being —13°, on the 17th, which was the coldest day of the season. There being no snow on the ground until January 10, the frost penetrated to a depth of 4 feet in places.

The month of February was also characterized by low temperature, the mean being 21.57°, which is about 3° below the average for that month. The total snowfall for the month of February, viz., 48 inches, was much above the average. A storm occurred on the 10th, giving 10 inches, and one on the 22d, giving 17 inches. The latter was accompanied by a heavy wind, which piled the snow in drifts.

The first of March there was snow on the ground to the depth of 15 inches, but heavy rains of the 12th and 15th removed nearly all of it, leaving the ground protected only in sheltered places. There was a thunder-storm the night of March 14.

The mean temperature of April and May was 48.82°, being about 2° below the average. The month of April was unusually cold, with strong north-westerly winds. Seven inches of snow fell during the month, and on the morning of the 26th the surface of the ground was frozen to the depth of 1 inch, the temperature going as low as 25°. Thus, owing to the low temperature of this month, the spring season was backward.

The average mean temperature for June, July and August was 67.38°, being about the normal. The total precipitation amounted to 8.91 inches, being 3.55 inches below the normal.

The rainfall for July, viz., 2.59 inches, was 2 inches below the average.

Thunder-storms were of frequent occurrence during July and August, but were of short duration. The want of rain injured the vegetation in this section.

On the 24th and 29th of August there were rain-storms, accompanied by unusually heavy winds, which did considerable damage to crops, blowing much fruit from the trees and injuring many fruit and shade trees.

The mean temperature for September, viz., 55.70°, was 4° below the normal. There was a slight frost on the 3d, which was the first of the season, but there were no damaging frosts during the month. The rainfall was about 1 inch below the normal.

The mean temperature for October was about 3° above the normal, while the rainfall was about the normal.

The mean temperature for November was about the normal, while the precipitation was 1 inch below. There was a slight fall of snow on the 3d, some of the surrounding hills being white.

The mean temperature for December was 24.60°, being 2° lower than that for December of last year. The minimum temperature of the month (—13° F.) came on the 14th. A snow-storm on the 4th, giving about 6 inches, with small additions at intervals, furnished good sleighing during the month.

## *Summary of Meteorological Observations, 1893.*

| | Temperature, Degrees Fahrenheit. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 A.M. | 2 P.M. | 9 P.M. | Mean. | Mean Maximum. | Mean Minimum. | Absolute Maximum. | Date. | Absolute Minimum. | Date. | Greatest Daily Range. | Date. | Least Daily Range. | Date. | Mean Daily Range. |
| January, | 13.39 | 21.84 | 14.39 | 14.48 | 24.64 | 4.97 | 50.00 | 2d | -13.00 | 17th | 32.00 | 22d | 9.00 | 5th | 19.68 |
| February, | 18.25 | 27.50 | 22.97 | 21.57 | 31.07 | 12.07 | 49.00 | 10th, 15th | -6.00 | 6th | 47.00 | 6th | 3.00 | 13th | 19.00 |
| March, | 25.68 | 36.35 | 29.81 | 29.59 | 38.90 | 20.29 | 48.00 | 14th | 3.00 | 3d | 30.00 | 30th | 4.00 | 11th | 18.61 |
| April, | 37.50 | 49.10 | 41.70 | 41.90 | 51.93 | 31.86 | 66.00 | 1st | 20.00 | 3d, 7th | 35.00 | 1st | 7.00 | 15th | 20.06 |
| May, | 51.90 | 64.68 | 54.86 | 55.74 | 67.42 | 44.06 | 84.00 | 23d | 31.00 | 8th | 43.00 | 11th | 9.00 | 3d, 27th | 23.36 |
| June, | 61.90 | 74.66 | 64.76 | 66.53 | 77.90 | 55.16 | 93.00 | 20th | 43.00 | 2d | 38.00 | 10th | 6.00 | 23d | 22.74 |
| July, | 63.96 | 76.64 | 63.84 | 67.50 | 80.26 | 54.74 | 90.00 | 22d | 42.00 | 25th | 37.00 | 21st | 11.00 | 29th | 25.52 |
| August, | 62.84 | 77.77 | 65.55 | 68.13 | 80.87 | 56.00 | 94.00 | 10th | 40.00 | 14th | 39.00 | 9th | 9.00 | 20th | 24.87 |
| September, | 49.80 | 65.06 | 54.30 | 55.71 | 68.20 | 43.23 | 81.00 | 10th | 31.00 | 27th | 40.00 | 9th | 10.00 | 15th | 24.97 |
| October, | 52.58 | 60.68 | 50.03 | 51.79 | 63.71 | 39.87 | 79.00 | 9th | 22.00 | 31st | 41.00 | 17th | 8.00 | 4th | 23.84 |
| November, | 34.00 | 44.53 | 35.40 | 37.06 | 46.80 | 27.33 | 62.00 | 2d | 10.00 | 27th | 33.00 | 11th | 4.00 | 29th | 19.36 |
| December, | 21.40 | 28.60 | 25.20 | 24.60 | 34.20 | 15.00 | 52.00 | 25th | -13.0 | 14th | 35.0 | 26th | 5.0 | 29th | 19.10 |
| Sums, | 493.20 | 627.41 | 522.81 | 534.60 | 665.90 | 404.58 | - | - | - | - | - | - | - | - | 261.11 |
| Mean, | 41.10 | 52.28 | 43.57 | 44.55 | 55.49 | 33.72 | - | - | - | - | - | - | - | - | 21.76 |

## Summary of Meteorological Observations, 1893.

### *January, February, March, April.*

| | 1892. | Date. | 1893. | Date. |
|---|---|---|---|---|
| Mean temperature, | 31.43° | - | 26.89° | - |
| Absolute maximum temperature, | 76.00° | Apr. 5, | 66.00° | Apr. 1. |
| Absolute minimum temperature, | —10.00° | Jan. 17, | —13.00° | Jan. 17. |
| Mean monthly range, | 18.84° | - | 19.34° | - |
| Total precipitation (inches), | 9.74 | - | 15.53 | - |
| Total snowfall (inches), | 34.00 | - | 71.25 | - |
| Last snowfall (inches), | trace | Apr. 10, | trace | Apr. 21. |
| Prevailing wind, | N. E. & N. W. | - | N. W. | - |

### *May, June, July, August.*

| | 1892. | Date. | 1893. | Date. |
|---|---|---|---|---|
| Mean temperature, | 65.32° | - | 64.47° | - |
| Absolute maximum temperature, | 94.50° | June 14, | 94.00° | Aug. 10, |
| Absolute minimum temperature, | 30.00° | May 1, | 31.00° | May 8. |
| Mean monthly range, | 21.21° | - | 24.12° | - |
| Last frost, | - | May 10, | - | May 8. |
| Total precipitation (inches), | 17.97 | - | 13.38 | - |
| Prevailing wind, | S. W. | - | N. | - |

### *September, October, November, December.*

| | 1892. | Date. | 1893. | Date. |
|---|---|---|---|---|
| Mean temperature, | 43.28° | - | 42.29° | - |
| Absolute maximum temperature, | 79.00° | Sept. 18, 19, 25, | 81.0° | Sept. 10. |
| Absolute minimum temperature, | —1.00° | Dec. 27, | —13.0° | Dec. 14. |
| Mean monthly range, | 18.47° | - | 21.82° | - |
| First frost, | - | Sept. 30, | - | Sept. 3. |
| Total precipitation, | 7.50 | - | 14.31 | - |
| First snowfall (inches), | trace | Nov. 5, | trace | Nov. 4. |
| Total snowfall (inches), | 5.43 | - | 15.25 | - |
| Prevailing wind, | N. W. | - | N. W. | - |

### *Entire Year.*

| | 1892. | Date. | 1893. | Date. |
|---|---|---|---|---|
| Mean temperature, | 45.68° | - | 44.55° | - |
| Total precipitation (inches), | 35.21 | - | 43.22 | - |
| Total snowfall (inches), | 39.43 | - | 86.50 | - |

## *Summary of Meteorological Observations, 1893.*

| 1893. | Precipitation, Inches. | | | | | Mean Dew Point. | | | | Relative Humidity. Per Cent. | | | | Wind. | Casual Phenomena. — Dates. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Amount. | Date of Greatest Fall. | Total Snow-fall. | Depth of Snow the 15th. | Depth of Snow at End of Month. | 7 A.M. | 2 P.M. | 9 P.M. | Mean. | 7 A.M. | 2 P.M. | 9 P.M. | Mean. | Prevailing Direction. | Thunder-storms. | Solar Halos. | Lunar Halos. | Aurora. |
| January, . . | 2.70 | 1, 2, | 13.25 | 3.00 | 7.00 | - | - | - | - | - | - | - | - | N. W. | - - | 18, 31, | 29, | - |
| February, . . | 5.55 | 22, | 48.00 | 7.00 | 15.00 | - | - | - | - | - | - | - | - | N. W. | - - | 11, 12, 28, | 1, | 5, 15 |
| March, . . | 3.62 | 11, 12, | 3.00 | - | - | - | - | - | - | - | - | - | - | N. W. | 14, | 7, 14, 27, | 31, | - |
| April, . . | 3.66 | 7, 8, | 7.00 | - | - | - | - | - | - | - | - | - | - | N. W. | 8, | 10, 12, 24, | 2, 26, | - |
| May, . . . | 4.37 | 3, 4, | - | - | - | - | - | - | - | - | - | - | - | N. W. | 23, 30, | 2, 10, 20, 23, 25, | 22, 28, | - |
| June, . . . | 2.93 | 22, 23, | - | - | - | 58.70 | 63.00 | 59.70 | 60.46 | 89.76 | 69.13 | 86.10 | 81.66 | N. | 4, 6, 11, 30, | 7, 14, 16, | - | - |
| July, . . . | 2.59 | 8, | - | - | - | 59.81 | 63.45 | 59.71 | 60.87 | 87.00 | 65.09 | 86.81 | 79.63 | S. W. | 1, 3, 5, 8, 10, 12, 17, 18, 22, 25, 26, | 22, 25, 28, 30, 31, | 28, | - |
| August, . . | 3.49 | 29, | - | - | - | 59.68 | 64.54 | 60.29 | 61.50 | 90.68 | 64.74 | 80.58 | 78.63 | N. | 1, 7, 12, 18, 19, 26, 27, | 4, 28, | - | - |
| September, . | 2.57 | 7, | - | - | - | 46.97 | 53.26 | 49.36 | 49.86 | 90.26 | 63.74 | 83.40 | 79.13 | S. W. | 7, | 1, 21, 26, | 27, | - |
| October, . . | 4.45 | 28, | - | - | - | - | - | - | - | - | - | - | - | S. W. | - - | 1, 13, | 20, 22, | 2, |
| November, . | 2.66 | 28, | - | - | - | - | - | - | - | - | - | - | - | S. W. | - - | 7, 8, 9, 21, 23, | 23, | 3, |
| December, . | 4.63 | 3, 4, | 15.25 | 8.00 | 4.00 | - | - | - | - | - | - | - | - | N. N. W. | - - | - | 21, | - |
| Sums, . . | 43.22 | - | 86.50 | - | - | 225.16 | 244.25 | 229.06 | 232.69 | 357.70 | 262.70 | 336.89 | 319.05 | - | - - | - | - | - |
| Mean, . . | 3.60 | - | - | - | - | 56.29 | 61.03 | 57.26 | 58.17 | 89.42 | 65.67 | 84.22 | 79.76 | N. W. | - - | - | - | - |

## ANNUAL REPORT OF C. A. GOESSMANN,

### TREASURER OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION

*For the Year Ending Dec. 20, 1893.*

RECEIVED.

| | | |
|---|---|---|
| Cash on hand from last year, | $462 67 | |
| Cash from State Treasurer, appropriation, | 10,000 00 | |
| Cash from fertilizer account, | 2,730 00 | |
| Cash from dairy bureau, | 13 00 | |
| Cash from farm, | 1,109 45 | |
| | | $14,315 12 |

EXPENDED.

| | | |
|---|---|---|
| Cash paid salaries, | $4,879 98 | |
| Cash paid laboratory supplies, | 356 18 | |
| Cash paid printing and office expenses, | 763 41 | |
| Cash paid farmer and farm labor, | 2,430 82 | |
| Cash paid farm supplies, | 1,778 21 | |
| Cash paid fertilizer account, | 2,726 03 | |
| Cash paid construction and repairs, | 450 19 | |
| Cash paid expense of Board of Control, | 142 91 | |
| Cash paid incidental expenses, | 325 99 | |
| Cash paid library, | 208 75 | |
| Cash on hand, | 252 65 | |
| | | $14,315 12 |

### SUMMARY OF THE PROPERTY OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION (DEC. 31, 1893).

| | | |
|---|---|---|
| Live stock, | $527 00 | |
| Tools, implements and machinery, | 978 30 | |
| Produce on hand, | 738 59 | |
| Fertilizers, | 186 70 | |
| Laboratory inventory, | 3,526 27 | |
| Office furniture, library, etc., | 2,138 50 | |
| Furniture, herbariums, library and collections, | 1,530 87 | |
| Photographic supplies, | 175 00 | |
| Greenhouse apparatus, | 117 50 | |
| Mycologists' apparatus, | 486 20 | |
| Chemical apparatus and supplies, | 326 85 | |
| Buildings, land, etc., | 32,202 00 | |
| | | $42,933 78 |

This is to certify that I have examined the books and accounts of Charles A. Goessmann, Treasurer of the Massachusetts Agricultural Experiment Station, for the fiscal year ending Dec. 20, 1893, and find them correct, and all disbursements properly vouched for, with a balance in the treasury of two hundred and fifty-two and sixty-five one-hundredths dollars, which is shown to be in the bank.

WM. R. SESSIONS,
*Auditor.*

JAN. 10, 1894.

# LIST OF EXCHANGES.

Reports and Bulletins of the United States Department of Agriculture, Washington, D. C.
Reports and Bulletins of the Agricultural Experiment Stations of the United States.
Bulletins of the State Board of Agriculture, Boston, Mass.
The American Cultivator, Boston, Mass.
The Holstein-Friesian Register, Boston, Mass.
Farm-Poultry Monthly, Boston, Mass.
Massachusetts Ploughman, Boston, Mass.
New England Farmer, Boston, Mass.
The Home and Mart, East Boston, Mass.
The American Nation, Boston, Mass.
New England Homestead, Springfield, Mass.
Farm Folks, Springfield, Mass.
Mirror and Farmer, Manchester, N. H.
New York Weekly World, New York, N. Y.
German Agricultural and Horticultural Journal (German), New York, N. Y.
American Agriculturist, New York, N. Y.
The Florists' Exchange, New York, N. Y.
Vick's Magazine, Rochester, N. Y.
The American Analyst, New York, N. Y.
Naturalist Monthly Bulletin, Philadelphia, Pa.
The Practical Farmer, Philadelphia, Pa.
The Farm Journal, Philadelphia, Pa.
The National Stockman and Farmer, Pittsburg, Pa.
Journal of the American Philosophical Society, Philadelphia, Pa.
Contributions from the Botanical Laboratory of the University of Pennsylvania, Philadelphia, Pa.
Veterinary Magazine, Philadelphia, Pa.
Maryland Farmer, Baltimore, Md.
Baltimore Weekly Sun, Baltimore, Md.
Creamery and Dairy, Waterloo, Iowa.
The Agricultural Epitomist, Indianapolis, Ind.
The New Agricultural Era, Indianapolis, Ind.
The Clover Leaf, South Bend, Ind.
The Orange Judd Farmer, Chicago, Ill.
The Western Swineherd, Geneseo, Ill.

The Dairy Messenger, Chicago, Ill.
The Dairy World, Chicago, Ill.
German Agricultural and Horticultural Journal, Chicago, Ill.
Detroit Free Press (weekly), Detroit, Mich.
University Record, Ann Arbor, Mich.
Farmers' Home Weekly, Dayton, Ohio.
American Grange Bulletin, Cincinnati, Ohio.
Journal of the Columbus Horticultural Society, Columbus, Ohio.
The Louisiana Planter, New Orleans, La.
Hoard's Dairyman, Fort Atkinson, Wis.
The Wisconsin Farmer, Madison, Wis.
The Weekly Journal, Sioux City, Iowa.
Hospoda (Bohemian Journal), Omaha, Neb.
The Industrialist, Manhattan, Kan.
The Home and Farm, Louisville, Ky.
The Industrial American, Lexington, Ky.
Journal of the Elisha Mitchell Scientific Society, Chapel Hill, N. C.
Southern Cultivator, Atlanta, Ga.
Monthly Florida Bulletin, Tallahassee, Fla.
West American Scientist, Los Angeles, Cal.
California Cultivator and Poultry Keeper, Los Angeles, Cal.
Journal of the Geographical Society of California, San Francisco, Cal.
Publications of the Department of Agriculture, Quebec, Canada.
The Journal of Agriculture, Montreal, Canada.
Bulletins of the Central Experiment Farm, Ottawa, Canada.
Industrial Journal of Agriculture, Montreal, Canada.
Agricultural Students Gazette, Cirencester, England.
Berichte der Landwirtschaftliche Verssuchstation, Halle, Germany.
Bulletins Ministere de l'Agriculture, Paris, France.
Bulletins of the College of Agriculture, Tokio, Japan.
Bulletins of the Department of Agriculture, New South Wales, Australia.
Agricultural Gazette, New South Wales, Australia.
Bulletins of the Department of Agriculture, Brisbane, Queensland, Australia.
Garden and Field Journal, South Australia.
Journal of the Council of Agriculture, Hobart, Tasmania.
Relatorio Annual da Estacao Agronomica de Campinas, Sao Paulo, Brazil.
Ragguagli, Laboratorio Chimico Agrario di Bologna, Bologna, Italy.
Reglamento, etc., Estacion Agronomica del Instituto Agricolo de Alfonso XII., Madrid, Spain.

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